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FALL MIGRATION OF THE BLACK DUCK



SPECIAL SCIENTIFIC REPORT: WILDLIFE No. 19

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

SPECIAL SCIENTIFIC REPORTS

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FALL MIGRATION OF THE BLACK DUCK

by

C. E. ADDY

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INTRODUCTION

This paper brings together the results of black-duck banding throughout North America, and attempts to show, for the benefit of sportsman and administrator alike, where the birds of Barnegat Bay, St. Clair Flats, or any other important hunting area come from. The banding may shed some light also on the questions when do the various groups of birds move and when might they be expected to arrive from certain regions to the north under conditions existing today.

The black duck, Anas rubripes, so closely related to the mallard and yet in many ways so different, is restricted largely to the territory east of the Mississippi in the United States and from Ontario eastward in Canada. Apparently the range of the black duck was at one time more restricted with fewer birds along the Mississippi River. About 60 years ago the black began to extend its range westward (Griscom 1949). Today there are reports of broods in North Dakota (Hammond 1950), and of a few flying birds in Montana (Griffith 1947), and in Alberta and Saskatchewan (Wright 1947) during late summer. It has become a frequent migrant in states bordering the Mississippi River on the west, from North Dakota to Texas, and now occurs rather frequently in Manitoba in the late summer and fall. According to 1951 hunter bag checks, the species made up about 3 percent of the bag of waterfowl in the Mississippi Flyway and about 24 percent of the bag in the Atlantic Flyway (Crissey 1951). In recent midwinter inventories, the blacks made up nearly 4 percent of the Mississippi Flyway population and almost 12 percent of the Atlantic Flyway population. From the continental standpoint the black duck is but a small part (roughly 3 percent)

of the waterfowl population (FWS 1950), but to the northeastern seaboard gunner the black is all important. In New England it makes up nearly half the annual bag.

Of major importance in present-day management is a comprehensive knowledge of the origins, destinations, and routes of waterfowl. Although the flight north in the spring has some significance, it is the return flight in the fall that counts most. This is the flight which commands the attention of the duck hunter, who wants to harvest his share, and of the technician and administrator who have determined what the annual take should be.

Data Used and Qualification of Terms

This report is primarily an analysis of migration based on banding data. Therefore, at the outset it is desirable to define the data used and discuss the more important factors or biases involved. A discussion of the man-made and natural influences on the continental migration or movements of the black duck is important as a background for what follows.

The data used are the records of fall shooting recoveries of black ducks that were banded at a series of points in the breeding and wintering ranges and along migration routes. All records of shooting recoveries (total 15,481) on file at the Patuxent Research Refuge, Laurel, Maryland have been analyzed. These records cover the period from the beginning of the black-duck banding, in 1918, through January 1951.

Considering first the newly banded population at a particular point on the breeding grounds, the question arises: Just what does this banded population actually represent? Obviously, flightless juveniles banded during the summer are representative of birds raised on that particular marsh. They may be representative also of blacks raised on nearby marshes and conceivably may even typify populations from a much wider area covering an important geographic region. We know little of the geographic limits of areas producing black ducks with similar migration habits, nor do we yet have an accurate measure of production in much of the breeding range. Without this information, it is not possible to determine the number of blacks migrating from a particular banding locality and the importance of the bands from one location as compared with those from another. For example, an equal number of birds might be banded on the breeding grounds at area A and at area B. Area A is extensive and supplies 10 times as many birds to the flyway as does area B. Recoveries from the bandings at A should be given 10 times the value of those bandings at B. Since we do not have this information, we cannot properly evaluate the data in comparing the two areas.

An important question is whether all segments of a population present in certain areas along migration routes or on wintering grounds are equally susceptible to trapping. For example, in a location that serves both as a stopping point during migration and as a wintering area, there is a question, discussed later in the report, whether the migrating birds are as easily trapped as the wintering birds. If the migrants are not as easily trapped, trapping at the location does not sample the population present in a representative manner.

In using recoveries as a basis for migration studies, it should be kept in mind that:

1. A bird removed from the population by means other than live-trapping is not available to be taken at some other time or place.
2. The proportion of the banded population that is removed at any one point is influenced by the hunting effort in relation to the number of birds available. Although substantiating data are lacking it seems logical to assume that the proportion of birds removed from the population is not constant among the various shooting localities.
3. It has been demonstrated with a limited series of bandings that the offer of a reward encouraged a return of three times as many bands as normal. This indicated that many bands are never turned in. It seems logical that even limited publicity campaigns affect the proportion of the bands turned in and reduce the validity of the data for comparison purposes.

Other factors such as the heavy kill associated with opening days, the length of time birds would normally stay in a particular area, variations in weather, changes in the legal open season, and changes in habitat and habits of the species, all influence the number of banded birds taken. Although there may be some tendency for these factors to average out over a period of years, care should be taken in weighing their effect when comparing banding data. Unfortunately, at present we have no reliable method for determining correction factors for these various items. This leaves us no alternative but to use the recovery data at face value and adjust our conclusions by use of circumstantial evidence and our knowledge of the habits of the species.

Recovery bands, whether from birds shot, trapped, or found dead, will always be in direct proportion to man's activities. In the settled parts of the continent, the birds will be hunted wherever they are found during the open season. Recoveries from shooting within the United States, therefore, come the closest to being reasonably represent-

ative of distribution. With other methods of recovery, this may not be so. A large number of birds are taken each year in muskrat traps. A heavy recovery in one area and a lesser one in another may not be indicative of a difference in the movement of birds. This difference could have resulted because the trapping season was open during migration in one area, but closed in another. Then too, the method of trapping in one area could account for the difference.

Hickey (1951) has ably presented the case with mallard bandings and concluded that bait trapping injected a bias by "conditioning" the birds for the particular banding area involved. Hickey feels that a correction factor can be worked out for individual banding stations to remove bias introduced by "conditioning." In some instances this may be possible but in others, coastal areas, for instance, where migrant and wintering populations are involved it seems that the problem would be hopelessly complicated by variables.

We have gone into some detail on certain factors or biases affecting the distribution of banding recoveries. Wherever possible we should eliminate or segregate the data likely to cause great distortions. Definitions of terms and classifications of data that have been used in this report and those that have not, are as follows:

1. The seasons of fall, winter, and spring are regarded as follows:

Fall - June to January (through shooting season).
Winter - January and February.
Spring - March, April, and May.

2. Definition of recoveries:

Local - taken within 50 miles of the banding station.

Direct - Banded during the period June to December, and taken anytime during this same period or during the following January.

Indirect - Recoveries in subsequent seasons, after the bird has had a chance to go through at least one intervening season of movement from the time of banding.

Another cause of difficulty in interpreting banding data is the lack of consistency in the various banding operations. Not only were many important bandings completed long before the present era of widespread, heavy shooting, and short split seasons, but many stations were not operated continuously.

Just how to interpret banding recoveries from the vicinity of the banding station is a knotty problem indeed. Considerable distortion occurs in the over-all data due to the extreme variations in the "take" around the banding stations. Some of the factors having a bearing on this may be variations in hunting pressure, baiting, location of trapping or baiting in relation to hunting areas, and perhaps variations in the habits of the birds themselves. With such local influences causing distortion, one is tempted to disregard the local kill and use only those records that portray movement. In some instances this might be justified but in a report dealing with the entire range of a species not all situations lend themselves to this approach particularly where sedentary populations are involved. To partially offset this disturbance and to put the various stations on a more nearly equal basis where direct or same-season recoveries are concerned, more emphasis is given in this report to recoveries from ducks banded before the shooting season and to recoveries in subsequent fall periods (indirect).

3. Bandings during the shooting season:

All indirect recoveries or those taken during subsequent shooting seasons from this group of bandings in the United States have been used. Both direct and indirect recoveries from Canadian bandings during the shooting season have been used, since the problems of local shooting in conjunction with bait trapping are small or non-existent. Because of the possible variation and complications between stations arising from shooting in the vicinity of active bait traps, direct or same-season recoveries from bandings during the shooting season are not used for comparative purposes. These latter records are considered as a special group and are referred to in the report for supplemental information only.

4. Pre-hunting-season bandings:

These include birds banded in the fall up to 5 days before the local hunting season begins. All fall shooting recoveries from these bandings have been tabulated and most of them are mapped and fully considered in the report.

5. Indirect recoveries from bandings during the winter and spring are considered fully.

6. For the sake of consistency, only those recoveries during the fall due to shooting are used. Unless there was reason to believe otherwise, birds noted as "found dead" or "found injured" during the open season were considered as deaths due to shooting. Recoveries in the spring illustrate the movement northward to the breeding ground and are not included in this report.

7. To facilitate interpretation of the data from various banding stations the distribution of records is shown on outline maps. Where the records are not too voluminous, all recoveries from a particular station are mapped; in other instances, where large numbers of recoveries are involved from bandings over a period of years, a representative series was selected.

8. Following is a breakdown of the fall recoveries of black ducks which serves as a basis for this report.

Total Shooting Recoveries - - - - -	15,481
Total Direct Recoveries - - - - -	6,673
Total Indirect Recoveries - - - - -	8,808
Total Direct and Indirect Recoveries Used -	12,410
Total Direct Recoveries from Bandings - - -	3,071
During the Shooting Season in the States (these used for supplemental data only)	

These records include the following from bandings in Canada.

Total Shooting Recoveries - - - - -	1,405
Total Direct Recoveries - - - - -	994
Total Indirect Recoveries - - - - -	411

A breakdown of other methods of recovery during the fall (not used in the report) is as follows:

	<u>Direct</u>	<u>Indirect</u>
Found dead	19	89
Found injured	1	16
No information	13	71
Steel traps	67	129
Duck traps	17	91
Killed by animal	5	15
Band found	2	13
Other	<u>2</u>	<u>20</u>
	126	444

Sex and Age Determination

Unfortunately early records on age and sex data are not as accurate as the data from certain bandings of the last few years. Had it been possible to analyze the records used for this report for differential movements, the value of the report would have been enhanced considerably.

FALL MIGRATION

Northern Bandings

We have pointed out some of the factors that may cause distortions in the data, and we are impressed by the narrow limits within which the banding data may be used in a study of black-duck migration throughout its range. With this background we shall proceed with a discussion of the recoveries station by station and region by region, using the records at their face value but evaluating their relative importances where the evidence seems to warrant.

With maps before us showing the plotted records from all the important banding stations across the country, we are impressed by the wide scattering of recoveries and the considerable overlap of patterns between stations, even with those as widely separated as Munuscong in Michigan and Seugog in Ontario or Rochester in New York. At a glance one realizes that it would be difficult to separate particular populations throughout most of the interior of the range. Only in the extreme eastern and western parts are routes of travel from north to south relatively restricted in width. The flight along coastal New England is perhaps the best defined. But even birds of this flight lose their identity south of Long Island as they mix with blacks coming out of the northwest part of the Atlantic Flyway. Likewise birds coming south from Wisconsin seem to follow a relatively narrow corridor, but soon become involved with flights originating in the region from Lake Michigan to at least southeastern Ontario. This vast interior territory supplies birds not only to the Mississippi Valley but to the middle and south Atlantic coastal region as well.

For management purposes a knowledge of the performance of unit populations is desirable. To arrive at a decision as to what might logically be considered separate units of population from the standpoint of similarity in migration patterns, it would be well to discuss the migration patterns from each banding station and combine those that appear similar or closely related.

Labrador - Quebec

Beginning with Tinker Harbor, Labrador, the northernmost of the eastern Canadian stations, we find a limited number of recoveries (56). These few recoveries indicate a rather well defined coastal migration with its southern limit as far as Georgia. South of the station approximately 29 percent of all the recoveries (direct and indirect) were in the Maritime Provinces, 27 percent in coastal New England, (34 percent with Long Island) and 41 percent from Long Island south. The direct or first-season recoveries reach as far south as Georgia, whereas the indirect recoveries (later seasons) end at Virginia.

It is regrettable that more black ducks were not banded in this important northern area, for at the present time there are not enough recoveries available to give us a complete distribution pattern. This situation is offset to some extent, because records from Tinker Harbor can be combined with those of the Quebec station since they show a similar distribution.

The Baie Johan Beetz station, Quebec, south-southwest of Tinker Harbor, on the north shore of the Gulf of St. Lawrence, has been in operation for the same number of years as the Labrador station (since 1947). Most of these northern bandings have been during August and September. To show more graphically the distribution of recoveries from Baie Johan Beetz bandings and the relation to the Tinker-Harbor station, percentages on a regional basis are grouped as follows:

	<u>Tinker Harbor</u>	<u>B. J. Beetz</u>	<u>Average Total</u>
Maritime Provinces and Newfoundland	28.5	31.3	30.4
New England States	26.7	23.1	24.2
Long Island south	41.0	41.2	41.1

From this distribution it is apparent that we can justify combining these two stations and for the time being at least consider the southern Labrador and southeastern Quebec areas as a unit. Wright (1948) in a discussion of these bandings likewise concluded that both stations were sampling largely the same population of birds. The individual records from these stations plotted on a map show a rigidly coastal (largely tidal marsh) location of the recoveries (fig. 1.*). This is particularly true with the direct or same-season recoveries. The same holds true for recoveries during subsequent years (fig. 2) although there seems to be a slight tendency toward dispersal westward in Quebec. That the coastal route is preferred by blacks coming out of this north country is evidenced by the fact that the Quebec birds seem to go south and southeasterly to the Maritime Provinces and stick to the coastal habitat all the way to the southern states, crossing land only occasionally, as in southeastern New England. It would seem that if any inland migration of consequence took place, a few shooting records other than those across extreme southeastern New England would be obtained.

* On maps showing the distribution of recoveries the banding station is located within the circled area. This circle embraces an area up to 50 miles from the point of banding. All recoveries within this 50 mile radius are considered as local recoveries. The number of local recoveries is given under the Figure heading.

South of Long Island, flights are restricted largely to the eastern shore of New Jersey and the eastern shores of Delaware, Maryland, and Virginia (largely avoiding the Chesapeake Bay marshes).

An interesting aspect is that southern New Jersey accounts for nearly half (25) of the direct recoveries from Long Island south (total 53; or 44 percent) and amounts to about a fifth of all direct recoveries from the Labrador and eastern Quebec bandings (total 119).

Newfoundland

The next station of importance to the south is Grand Codroy River, Newfoundland. Here again the recoveries both direct (53) and indirect (31) are few, but there are probably enough records to give a general indication of the route of travel. It is apparent from the mapped records that this banding represents a population of birds not too closely associated with the populations in Labrador and eastern Quebec. At least there is not the strong migrational characteristics exhibited by the mainland blacks. Actually these Newfoundland birds occupy many of the same marshes as the Labrador and Quebec birds during migration, but the Newfoundland blacks apparently do not go farther south than Cape Cod or eastern Long Island in any significant numbers during the shooting season (fig. 3). There is the possibility of a more important southern penetration late in December, for as is demonstrated later (p. 43) these Newfoundland blacks do not move until quite late in the season. Approximately 90 percent of all recoveries were obtained from Long Island north. The largest kill of banded birds occurs in Nova Scotia where 38 percent of the recoveries are reported. Eight percent and 13 percent are from Prince Edward Island and Massachusetts, respectively. Recoveries in the vicinity of the banding station amounting to about 18 percent indicates a local hunting pressure in Newfoundland which is not present at the Labrador-Quebec stations. In all probability the Newfoundland blacks might be considered a strictly Maritime unit, occupying outer coastal waters almost exclusively, with some of the population going regularly to the Maryland, Delaware, and New Jersey coasts but with the bulk of the birds occupying the coastal area from Long Island north, at least during the fall period.

Maritime Provinces

Banding was started in Nova Scotia in 1922 and in New Brunswick in 1928. But at both stations it has been limited, with total recoveries for Nova Scotia only 35 and for New Brunswick 89. Most of these blacks were banded as juveniles on marshes that were subjected to extremely heavy fall hunting that started in September. As a result, there is a heavy kill of local ducks, apparently late migrators. About three-fourths of the banded birds recovered were shot within a 50-mile radius of where the birds were trapped. The majority were taken on the same marsh where, as flightless juveniles, they had been banded 6 to 8 weeks previously. With the leavy local kill accounting

for 75 percent of the recoveries, it is difficult to compare the migration pattern with that of stations to the north. The fact that 90 percent of all New Brunswick recoveries were taken the same fall as banded indicates an unusually heavy early kill. The recoveries from the New Brunswick bandings end in the Delaware-New Jersey area for the most part, although there is one record for Florida.

It is anticipated that more extensive bandings will be undertaken during the coming years in the Maritime Provinces which will shed more light on the extent of movement of locally raised black ducks. Since Nova Scotia supports a fair wintering population in some years, it is possible that banding, at least on the southern tidal marshes, may not show the true extent of migration. This condition is discussed further in connection with Massachusetts bandings.

Maine

Bandings have been carried on at several points in eastern Maine, beginning in the early twenties. Recoveries total 298. The most important location has been the Penobscot Valley, where in recent years the Maine Cooperative Wildlife Research Unit has embarked on an expanded banding program. Limited and scattered banding has been done on tidal areas, but the greater portion has been on fresh water, usually within 50 or 60 miles of the coast. Only with the Penobscot River bandings were significant numbers of blacks banded before the shooting season. Records from this station make up about two-thirds (188) of all the recoveries. The plotted direct recoveries from the Penobscot River station (totaling 109) show an interesting pattern which conforms remarkably with the strong coastal migration pattern exhibited by the blacks from eastern Quebec and Labrador. The mapped recoveries (fig. 4) indicate that these birds probably migrate down the Penobscot Valley to the coast, then follow the coastal habitat most of the way to the southern wintering areas. The southernmost recovery point is South Carolina and approximately 48 percent of the records are from Long Island south. If we exclude Long Island, we still have 39 percent of the recoveries occurring from New Jersey south. Here again New Jersey takes a significant percentage, 16 percent.

The kill, within a 50-mile radius of the Penobscot River station, counted for about 21 percent of the recoveries. This is not excessive in comparison with other stations farther south along the coast. The 62 indirect recoveries, with 45 percent or 28 recoveries from Long Island south, reflect the pattern of the direct recoveries.

Details of the southern distribution of indirect recoveries differ somewhat from the directs. Maryland rather than New Jersey accounts for the greatest number of indirect recoveries, the number being 11 percent. Only 8 percent of the indirect recoveries were taken within a 50-mile radius of the station. Of the New England states, Massachusetts leads with 13 percent. Among the indirect recoveries, the southernmost record is from Florida.

Only a few indirect recoveries occur north of the banding station. This indicates the early fall bandings on the Penobscot River are dealing primarily with a local population originating largely from within Maine itself.

Massachusetts

Over a period of some 20 years, more black ducks have been banded in Massachusetts than in any other State or Province with the exception of New York. Practically all the banding has been done on tidal marshes or nearby areas on Cape Cod and in the vicinity of Newburyport near the New Hampshire line, though there have been miscellaneous bandings on various islands and at scattered points across the interior of the State. Bandings during fall, winter, and spring are represented from both the Newburyport and Cape Cod stations.

Starting with the more northerly station, Newburyport, we find a total of 665 recoveries for all fall bandings. Of these, 299 may be classed as directs banded before the hunting season, 295 as indirects, and the remainder as direct recoveries from bandings during the hunting season.

One would expect that the 299 direct recoveries would show a well-distributed spread into the Middle Atlantic States, if they were consistent with recoveries from bandings farther north. This is not the case, for approximately 83 percent of these recoveries were within 50 miles of the point of banding. There is a dribble of records as far south as North Carolina and about the same number north into Maine.

Roughly 8 percent of the recoveries were from Long Island south, and 7 percent were from the southern New England area. This dispersal pattern of the southward recoveries (fig. 5) is similar to that of the Maine, Quebec, and Labrador stations, but the volume is far from that which would be anticipated, particularly since some of the northern banded birds were actually killed at Newburyport on the way south. The data from the more northern bandings, as well as recoveries from bandings along the coast from Virginia and North Carolina (see pp. 27-30), indicate that there must be a much heavier migration along coastal Massachusetts than is shown by the Newburyport bandings. Tabulations of bandings before the hunting season on Cape Cod, although fewer in number (102) show much the same trend. Seventy-six percent of the recoveries were taken locally and about 9 percent from Long Island south. Many blacks banded on the Cape during July and August exhibited late-summer northward movement into Maine, New Hampshire, New Brunswick, Ontario, and Quebec. This amounted to approximately 12 percent of the recoveries.

Why should Massachusetts coastal bandings show a very meager fall migration when the evidence from bandings over a wide area to the north shows a strong coastal migration right through the same areas

where the traps in Massachusetts were located? The answer probably involves a combination of circumstances each of which plays a part of unknown importance. Although a satisfactory explanation is not possible at the moment, a discussion of some of the factors is pertinent. But, before going into a discussion of these it would be well to examine briefly the remainder of the Massachusetts bandings.

Indirect recoveries of birds banded during the fall and taken in subsequent fall periods show 47 percent and 52 percent taken within a 50-mile radius of the banding stations at Newburyport and Cape Cod respectively, and the percent of southward recoveries is about the same as the first-season recoveries. These percentages of local recovery are not so high as those for some coastal areas to the south such as in Maryland and Long Island but seem to conform in a general way to bandings both on the coast and northern inland areas where large bodies of water are found and where a wintering population usually exists.

The indirect recoveries to the north of Newburyport show strong affiliations with the Maritime Provinces, Labrador, and Quebec, (fig. 6). These total 82 (28 percent) and Quebec alone accounts for 33 (11 percent). The indirects (total 772) to the north from Cape Cod fall bandings show similar ties with eastern Canada except that Newfoundland (2 percent) and Nova Scotia (14 percent) are involved to a greater degree. Eastern Canada accounts for 259 indirect recoveries from fall bandings on the Cape.

With winter bandings one would expect a very limited recovery south of the Newburyport station or the one on Cape Cod, since most of these birds were on the wintering ground when banded. Sixty percent of all fall recoveries for winter bandings at Newburyport (total 287) were taken in the immediate area of the banding station. This is some 12 percent higher than with indirect fall bandings and 13 percent lower than for direct first-season recoveries. The southward recoveries (10 south of New England) were only a little over 3 percent. Recoveries (146) from spring bandings (March-May) at Newburyport, during the period when most black ducks are on the move, show a close association of migrants at Newburyport with populations accustomed to wintering at least as far south as New Jersey. Twenty percent of these recoveries were taken south of New England with approximately 12 percent in southeastern New Jersey. Fifty-one percent were taken in the banding area in subsequent years, indicating that many of the spring-banded birds were not migrants from the south but actually individuals which had wintered at Newburyport.

Winter and spring bandings on Cape Cod (totaling 679 recoveries) give much the same results as fall bandings. Over half the reported recoveries were taken locally and there was only a dribble to the south of New England. The pattern of recoveries in eastern Canada from these bandings is similar to that of the fall-banded birds. Recoveries of Newburyport birds indicate stronger ties with the mainland than do the recoveries of the Cape Cod birds.

These circumstances, in which most of first-season recoveries are taken within the vicinity of the banding station, are not restricted to bandings in Massachusetts but occur at various other points down the coast and at certain areas through the interior as in Vermont and Michigan. At the moment it would seem that an explanation for one area may not hold with another, for circumstances appear to differ in different areas.

The relatively high percentage of locally banded birds recovered on the Massachusetts coast may possibly be explained by the fact that the local gun pressure is so intense that a heavy loss of ducks occurs before the birds normally migrate from the area. It would seem, however, that the heavy "take" of black ducks by hunters in the vicinity of the banding station, does not satisfactorily explain why these coastal bandings do not show a significant "through" migration.

Local hunting pressure undoubtedly contributes heavily to the lopsided distribution pattern of Massachusetts bandings. However, there seem to be other contributing factors, probably associated with the habits of the birds themselves and perhaps with the trapping methods, too. Part of the answer undoubtedly lies in the fact that the coastal marshes and bays of Massachusetts are wintering grounds for black ducks. It has been the experience of many of us who have observed black ducks over a period of years on the coast of Massachusetts that those birds that are going to stay become oriented to winter quarters soon after arrival. In fact some black ducks banded during the summer period at Newburyport never leave the vicinity and may be retrapped during the fall and throughout the winter. In other words, some black ducks which breed from Massachusetts south are actually permanent residents. Hagar (1946) in his excellent analysis of the Cape Cod bandings (Austin station), showed exceptionally prolonged repeating at the traps. It was his belief that most of the original fall population on the Cape could be accounted for by winter bandings and by the estimated hunting losses in the immediate area.

It has been the experience of the author and others that "repeating" in coastal traps in late summer or early fall develops immediately and in a few weeks most of the birds trapped each day are already banded and have established a strong "trap-habit". This happens also, to some extent on inland fresh-water areas in the northern states and Provinces but in these instances there is usually a "turnover" of much of the population over a 3-week period. In contrast, on the tidal marshes of Massachusetts and probably in states to the south, many of the black ducks trapped early in the season are retrapped later in the season. Only if the traps are moved, sometimes merely a few hundred yards, is an unbanded group of birds taken. In other words, many black ducks inhabiting the coastal marsh in early fall rapidly establish rather sedentary habits using the same limited section of marsh day after day unless driven out temporarily by gunning or other factors. Some of these birds eventually leave for the south when

weather conditions dictate. But a sizable portion probably remains as a unit, augmented from time to time by birds from the north, which soon establishes a wintering-ground behavior pattern. Hagar (1950) believes that for this group of birds, the establishment of winter territories or patterns is completed by December 5. This is probably true for some of the birds, though Massachusetts and points to the south usually receive important late flights of blacks from the north during December.

The deduction that must follow is that in our coastal trapping we are banding primarily a sedentary group of birds, to the exclusion or partial exclusion of a migratory or transitory population that is taken by hunters but not taken in significant numbers in traps. The question is whether the monopolization of the bait traps by the more sedentary "trap-happy" population is of such magnitude that it prevents adequate sampling of birds stopping momentarily enroute to the south. Baiting certainly influences local waterfowl movements and in this instance it is reasonable to deduce that some bias, however, subtle, has influenced the data. It is conceivable that bias associated with the trapping might be as important as anything else in producing an inaccurate sampling of the overall population. If this is true, it is doubtful that any amount of bait trapping on certain wintering grounds in the northern coastal states will yield even reasonably accurate data on the extent or importance of migration through that particular point.

There is additional evidence that along the coast many of the winter residents are actually banded during the fall. Indirect recoveries at later seasons indicate relatively minor movements south of the banding station.

Field observations tend to bear out the probability of trap selection. One who observes black ducks from day to day on particular tidal marshes readily differentiates between the old established flocks and new flocks which have just arrived. Usually the first birds to enter the traps are the banded ones that have acquired the trap habit. If there is any grain left in the trap, and if there has been no disturbance, some of the new arrivals may work up enough courage to join those in the trap. Probably it is the banded group that eats most of the grain placed in front of the trap to attract the birds.

Another factor to be considered is that some black ducks from the north probably do not ordinarily stop in New England on their way south. Under the section "Time of Migration" it is shown that some of the far-northern blacks migrating along the coast may make only one or two stops enroute. Apparently some blacks fly nonstop from the Maritime Provinces or Maine to New Jersey. Others apparently work their way down the coast gradually.

In contrast to the coastal bandings, the results of limited bandings on inland fresh-water areas show a stronger migration to southern areas in the flyway. Most of these stations are in the eastern part of Massachusetts through which some of the northern flight birds migrate when they leave the coast for a brief trip across south-

eastern New England (bypassing Cape Cod) on their way to southern waters. With the direct recoveries (44) from birds banded before the hunting season, 27 percent were reported from the southern coastal area from New Jersey to North Carolina. (With Long Island included the percent would be 32). In this group of birds the local kill amounts to 57 percent of the total recoveries. Incidentally, practically all recoveries from birds banded during the shooting season at inland points were taken near the site of banding. The fact that no recoveries were taken on the coastal marshes of Massachusetts further illustrates that this population was moving predominantly in a south-southwesterly direction toward the Middle Atlantic area.

Seventy-one recoveries in subsequent years show somewhat the same pattern except, of course, that the States and Provinces to the north are represented giving a more complete story on the performance of the population. Approximately 13 percent were recovered from the Maritime Provinces and Quebec, 26 percent in New England (not counting the local kill which amounted to 41 percent) and 20 percent in the south from Long Island to North Carolina.

We have given a detailed account of the banding results in Massachusetts because the problems in this State are similar to the problems elsewhere, though not in the same proportion, and also because much of the past and current sentiment regarding special shooting regulations for New England originated in Massachusetts. Proponents of special shooting regulations for New England have set forth as part of their argument that the black duck is the only important game duck in that section of the country, and that since the northeastern black does not appear to migrate to any extent south of New England or Long Island, special consideration should be accorded New England (Cross 1951, Hagar 1950). If this is so, then the wintering populations along the coasts of New England, the Maritime Provinces, and Newfoundland, plus the hunting kill represent most of the production of Eastern Quebec, Labrador, Newfoundland, the Maritime Provinces and New England. The midwinter waterfowl survey data, collected by the Fish and Wildlife Service, the State Game Departments, and private cooperators, during January when population movements are at a minimum, may furnish additional information of interest on this problem.

The following tabulation by regions gives the average winter population in the eastern coastal states for the 10-year period 1943 to 1952. Excluded is West Virginia.

The population for the Maritime Provinces and Newfoundland has been derived by averaging the available mid-winter inventories which cover the periods 1948 to 1952 for the former and 1950 to 1952 for the latter.

No.	Average Population	Percent-Flyway Population
1. Maritime Provinces and Newfoundland	45,785	10
2. New England States (Incl. Vermont)	61,956	14
3. Eastern Canada and New England (Areas 1 & 2)	107,741	24
4. Area #3 and including Long Island	126,032	28
5. New Jersey to North Carolina	249,496	56
6. Area #5 and including Long Island	267,787	60
7. South Carolina to Florida	68,658	15
Total Population	444,186	

From this it is apparent that the center of black duck distribution on the wintering grounds in the Atlantic Flyway is in the coastal region bounded on the north by Long Island and on the south by North Carolina.

Long Island should be considered an integral part of the Middle Atlantic region because diverse migration routes converge there and because it has similar ecological conditions. The winter population remaining in New England is but a minor portion of the Atlantic Flyway population, the bulk of which occurs in the Middle Atlantic States.

The trend from year to year of the Long Island and New England population does not always follow the trend of the entire Atlantic Flyway black-duck population (fig. 7). If the northeastern states were delineated as a separate region for regulation purposes, and their relatively small wintering black-duck population given primary consideration, there would be years in which a low mid-winter count in this region would necessitate unwarranted restrictions on the northeastern gunner. The black ducks of the Northern Atlantic States are actually closely associated with black duck populations farther south. The percentage of the northeastern black-duck population remaining along coastal New England during the winter is apparently not a constant one and may be influenced by climatic conditions and other factors.

This population or flyway theory originated in the late 1930's when Lincoln (1939), basing his conclusions on the only significant amount of data at that time, the Cape Cod bandings, stated the case as outlined above. Hagar (1945, 1946) later presented a thorough and detailed analysis of the Cape Cod bandings which he used as evidence of the existence of this more-or-less regional population. These investigators quite logically drew the conclusions they did, because the Cape Cod bandings were then the only important sources of data upon which to base judgment. About 1946 in Maine and 1947 in Quebec, Labrador, and Newfoundland, new stations were established for sampling the populations to the north. Sufficient numbers have been banded to indicate an entirely different pattern of movement than recognized by Lincoln and Hagar. These recent bandings show that throughout the fall there are black ducks flying coastal New England from their northern breeding grounds in Canada to wintering grounds from New England to the Carolinas.

The importance or size of these flights to areas south of New England has yet to be determined. Part of the answer can be obtained through indirect recoveries from blacks banded on the wintering ground in southern New Jersey and states to the south. These recoveries will be presented and discussed later in the report.

Connecticut

The next important group of bandings is from Connecticut, where most of the banding was done during the fall and spring. Practically none was done during the winter period. The bulk of the banding in the fall was carried out during the shooting season giving a total of 193 direct recoveries and 92 indirect. Of the direct recoveries there are only 34 available from birds banded before the hunting season. At least half a dozen stations are involved with the principal locations near the coast in the vicinity of Saybrook and East Lyme, and of lesser importance, on fresh water at Litchfield.

The Connecticut birds exhibit a major migration into the Mid-Atlantic states from New Jersey to North Carolina. Approximately 44 percent of the recoveries from birds banded before the hunting season (total 34) were taken in this mid-Atlantic region. If Long Island were included the figures would jump to 59 percent. Even with direct recoveries including those banded during the shooting season, in which 77 percent of the recoveries (total 136) were taken locally, there is evidence of close ties with populations in the states from New Jersey to South Carolina. In this southern region approximately 16 percent of the recoveries were reported. With the 92 indirect recoveries the pattern is somewhat the same as with the northern stations in that the limit of distribution does not extend as far south (Virginia) as it does with direct recoveries. Here again a heavy local kill is exhibited (62 percent) and approximately 11 percent was reported from New Jersey south. The distribution of records from spring bandings (117 recoveries) conforms very closely to the indirect recoveries from fall bandings.

Some of the Connecticut-banded blacks undoubtedly originated locally and from various points in other New England States. The Maritime Provinces are involved also but only as far as flights into the eastern part of the state are concerned. This is shown by Maritime-Province records from the East Lyme and Saybrook Stations in the southeast corner and the scarcity of such records for Litchfield, west of Hartford. This relationship between eastern Connecticut and the Maritime Provinces falls in line with the westerly portion of the main coastal flights coming out of eastern Quebec, Labrador, and the Maritime Provinces, eastern Maine, and northeastern Massachusetts. Many of these northern birds leave the immediate coastline principally in Massachusetts above Cape Cod, and cross overland through Rhode Island and eastern Connecticut on their way south. Both the spring and fall bandings for eastern Connecticut show this affinity for the Maritime region in the northeast and a strong relationship with coastal areas south to at least the Carolinas.

Long Island

For over 20 years there has been intermittent banding on Long Island and in the Bronx. The bulk of the banding has been done near the eastern end of the Island (Quogue and Southampton) and at the western end (Wantagh), and in the New York City area, mainly the Bronx. There is a relatively large volume of shooting records--1,750 from all seasons are available. Records from both ends of the Island have been tabulated and mapped separately. As would be expected the western portion of the island is involved to a greater degree than the eastern end with birds coming out of southern Quebec and the Champlain-Hudson valley region and to a limited extent eastern Ontario. However, the differences in distribution of indirect recoveries from the various stations does not appear great enough to warrant a detailed analysis at this time. With Long Island we find the first indication of the mid-western influence that becomes quite pronounced in the Flyway from South Carolina to Florida. With the indirect recoveries, there are single records for Minnesota, Wisconsin, Michigan, and Ohio.

Although the Long Island bandings are predominantly fall (1,091 recoveries), there are good series of records from winter (283) and spring (196) bandings. By a gross examination of the three series of tabulations, one finds a similarity in some respects with bandings on the coastal marshes of Massachusetts. Here again we find a heavy local take (80 percent) of first-season or direct recoveries. Even with the indirect recoveries 60 percent were taken locally. The distribution of direct recoveries south of the island (over 50 miles distant) is much the same as results from stations to the northeast. With the direct recoveries (273) banded before the hunting season, the southward records (to South Carolina) totaled 14 percent and the indirects (454) 9 percent. As was found with the summer bandings on Cape Cod, the Long Island birds exhibited a limited late summer northward movement at least as far as Ontario, the Maritime Provinces, Maine and Massachusetts. The indirect recoveries show the relationship of Long Island-banded birds with a somewhat more expansive territory to the north and west than was true for

the strictly New England stations, as one would expect. The east-west limits of the funnel of distribution extend from Newfoundland to Ontario. It is difficult, in some respects, to divide these recoveries into two groups but generally speaking there is a coastal group and a Lake Champlain-Hudson Valley group with a scattering of birds in between. Recoveries, expressed in percentages, are as follows:

Maritime Provinces and Newfoundland	9 percent
New England, except Vermont	7 percent
New York, Vermont, and Ontario	5 percent
Quebec	7 percent

Recoveries from winter-banded blacks (fig. 8) show much the same pattern except that 65 percent were taken locally and only 4 percent were taken south of the Island. With this group the eastern Canadian recoveries extended into Labrador, where the opportunities for getting recoveries are limited.

Records from bandings during the spring migration show much the same pattern as the fall records. Percentage-wise they break down as follows:

Maritime area	9 percent
New England, excepting Vermont	10 percent
New York, Vermont, and Ontario	3 percent
Southern Quebec	12 percent
Southern recoveries, principally to Virginia	3 percent

Vermont - New York

Vermont bandings from Lake Champlain, Lake Alice in the northeast corner of New York state and Tomhannock Reservoir in the Hudson Valley, show roughly similar patterns of movement, and are grouped together. It is somewhat debatable whether these records should be considered with the eastern group for they show a rather neutral position, with affinities to both east and west. The records for each are as follows: (Directs not including hunting-season bandings)

	<u>Direct</u>	<u>Indirect</u>
Lake Champlain	102	56
Lake Alice	40	19
Tomhannock	44	51

The flight route of these birds is restricted in width, following fairly closely the Champlain-Hudson Valley. With the Lake Alice Station there also are some birds that move in a westerly direction via the St. Lawrence River apparently to join the Mississippi flights.

In the Middle Atlantic States, the Champlain-Hudson Valley birds exhibit a tendency to spread inland from the outer coast (fig. 9) in contrast to the blacks from the northeast which showed a predominantly coastal pattern. For the most part, these Vermont and New York birds are restricted primarily to New Jersey and Delmarva Peninsula in their movements through the Middle Atlantic States. With the direct recoveries the most southern records are in Florida, whereas with the indirects, South Carolina is the southern limit.

Twenty-four percent of the direct recoveries were from New Jersey south, with only 4 percent from the coastal states south of Virginia. This is a somewhat lower percentage of recoveries taken in southern areas than that obtained from bandings in Maine and the Quebec-Labrador area. However, it is felt that the heavy local recovery (60 percent) from Lake Champlain and Tomhannock is undoubtedly responsible for this reduction in the number of southward records. Northern Lake Champlain in particular is not considered an important black duck wintering ground for most of the birds are eventually forced southward by weather. It seems to be characteristic of large water areas in the northern States where black ducks can settle down out of gun range, that the birds have a tendency to linger. Whereas with smaller habitats the initial gunning pressure is enough to drive the birds out of the country or keep them moving.

Indirect recoveries indicate a relation with the northeast Maritime area, as well as Ontario, western Quebec and central Pennsylvania (fig. 10). Perhaps some blacks follow up the St. Lawrence River to the east shore of Lake Ontario, thence across New York and Pennsylvania to the middle Atlantic area. Approximately 7 percent of the recoveries came from eastern New England and Maritime Canada. Thirty-three percent of the recoveries were taken in the middle Atlantic states from New Jersey to South Carolina, with the Carolinas accounting for about 6 percent. A number of the southern records were taken inland which may represent an overland migration as well as a coastal movement. Limited bandings on the St. Lawrence River in southwestern Quebec were carried out during the early 1930's at La Batture, 60 miles east of Quebec City and during 1950 at Sorel about 90 miles west of Quebec City. The distribution from the eastern station, with 25 records, indicates a closer relation to the Lake Champlain bandings than the pattern of distribution from the Sorel station. In the latter instance, however, there are too few records (14) upon which to base an appraisal.

Before going into a discussion of banding in the states from New Jersey south, it would be preferable to consider the Ontario, New York, and Pennsylvania bandings, since flights from these states intermingle with populations of the middle and south Atlantic coastal areas.

Ontario

An impressive series of recoveries (962) is available from bandings at Lake Scugog, Ontario, primarily from 1920 to 1926. Also included is one year, 1941, for Toronto.

Maps of the plotted direct and indirect recoveries (figs. 11 and 12) show an explosive pattern of dispersal. It covers most of the United States from the Atlantic seaboard in New Jersey to Florida and Louisiana on the Gulf Coast and from Texas north to western Kansas. The indirect recoveries are distributed through most of the United States east of the Plains and in Canada from Manitoba to western Quebec. New England and eastern Canada are apparently of little or no importance as far as the Ontario population is concerned because only 5 records are to be found.

Both direct and indirect recoveries show a southern Atlantic coastal grouping and a dispersal through the Ohio and Mississippi Valleys. For the most part, large river systems seem to be followed, although there are many scattered recoveries throughout the Mississippi Valley and the Appalachian mountain country. There are also a few areas of unusual concentration: the heaviest is along the shores of Lake Erie in Ohio, Michigan, and Ontario. These recoveries, located southwest of the banding station, undoubtedly are largely part of the Mississippi Basin flight with a minor portion mixing with the south Atlantic group from the Carolinas south. There is a fairly heavy concentration of recoveries in coastal South Carolina and a scattering between this point and the Lake Erie concentrations. There is another grouping of recoveries in the Chesapeake Bay marshes of Maryland and Virginia to northern North Carolina.

New Jersey and the outer shores of Delaware and Maryland show a marked scarcity of direct recoveries from Lake Scugog, amounting to about 4 percent. This is in contrast to those of the northeastern blacks which are concentrated along these outer shores. Only on the eastern shore of Virginia do the northeastern and Ontario birds show their first important mingling.

The majority of the Ontario blacks going into the Middle Atlantic area apparently occupy the inner marshes of Chesapeake Bay in Maryland and the western or mainland shore of Virginia. Northeastern North Carolina is important also with this group and there is undoubtedly some coastal movement on into South Carolina. The distribution of inland recoveries would lead one to believe that many of the South Carolina (and southern North Carolina) blacks arrive by inland routes, probably crossing the Appalachian Mountains. Most of the black ducks bound for the Middle Atlantic states probably fly directly from Ontario across central New York and Pennsylvania.

Continuing on down the coast we find that approximately 11 percent of the Ontario direct recoveries are from North and South Carolina, with the latter accounting for about two-thirds. About 4 percent were recovered in Georgia and Florida. From the standpoint of distribution, the percentage of Ontario direct recoveries in the Middle Atlantic states is less than that from some of the northeastern stations. In the south Atlantic area, however, there is a higher percentage of Ontario recoveries. Actually a comparison of these percentages may lead to erroneous conclusions but, as will be seen later, the results of the northern bandings apparently check with the recoveries from southern bandings (p.27).

Since the Ontario recoveries are so widely dispersed, grouping them by flyway and region is perhaps the best way to show relative distribution.

	<u>Percentage of recoveries</u>	
	<u>Direct</u> (672)	<u>Indirect</u> (290)
Atlantic Flyway		
Virginia north	20.9	30.3*
N. Carolina south	15.2	16.8
Mississippi Flyway		
Kentucky-Missouri north	19.3	15.5
Arkansas-Tennessee south	9.8	10.3
Central Flyway		
Nebraska north	0.0	0.7
Kansas south	1.2	0.0
Canada		
Eastern:	0.0	0.3
Ontario, including local and western Quebec recoveries	35.7	25.5
Western:	0.0	1.0

* New England portion amounting to only 1.4 percent of the 290 recoveries.

Indirect recoveries in the west shore region of James and Hudson Bays show a close relationship of the Scugog blacks with this northern region. The indirects reveal much the same distribution throughout the interior of the United States as the directs, with perhaps a more noticeable restriction of recoveries to major river systems including the Ohio, Mississippi, and Tennessee.

Banding was started in 1950 at Moosonee on James Bay. The 30 recoveries from this banding are too few to show a complete pattern of distribution. These records, however, indicate the possibility of a

stronger tie with the Middle Atlantic States than do the Lake Scugog data; 19 of the 30 recoveries came from the coastal states from New York to Maryland. There are 2 records from South Carolina but none from North Carolina, Virginia, or Long Island. Recoveries have been taken also in Ohio (3), Michigan (1), and Missouri (1).

New York

During the past 25 to 30 years at least six major banding stations have been in operation at various times in New York State, exclusive of Long Island. These have been fairly well dispersed from east to west across the state. Resulting data (2,121 recoveries) give excellent patterns of distribution showing the relation of the New York State black ducks to both the Atlantic and Mississippi Flyways.

The Lake Alice and Tomhannock Reservoir stations have already been discussed. Other stations are the Oak Orchard Game Management Area, Rochester, Cayuga Lake, Montezuma Refuge, Oneida Lake, and Perch Lake. With the recoveries for each of these stations mapped, variations in the distribution patterns between stations 50 to 100 miles apart are apparent. In general, the farther west in New York, the more influence there is from the Mississippi Flyway and the interior of the Atlantic States. For practical management purposes, it would appear that most of the records, direct and indirect, from Perch Lake, Montezuma, Oneida Lake, and Cayuga Lake agree so closely that these stations could be considered as a unit.

Principal differences in the migration pattern seem to be (1) that in the Chesapeake region, the Perch Lake records are relatively more predominant on the Eastern Shore, and (2) that there is a wider spread of recoveries into central New England to the east and the Mississippi River area to the west from the Perch Lake station than from the other three.

Greatest difference between stations seems to be in the number of recoveries within a 50-mile radius of the banding station. In the Montezuma region, this reaches 45 percent for direct recoveries and 32 percent for the indirect. Perch Lake recoveries amount to 24 percent for directs and 12 percent for indirects.

From the 296 mapped direct recoveries there is no indication of any particular route of travel across New York State. The birds probably leave upper New York by diverse routes, some eventually coming in on the lower Hudson River. Others apparently fly the Susquehanna and Delaware River systems in Pennsylvania, as evidenced by scattered recoveries (fig. 13).

South of Pennsylvania the birds diffuse over much of the Middle and South Atlantic Coastal States. Recoveries are most numerous in tidewater areas, though there are some inland records, particularly

in the Southern States. The heaviest concentration of records, both direct and indirect (totaling 273), is in the Chesapeake Bay area of Maryland and Virginia (25 percent), with lesser numbers in the New Jersey and Delaware area (12 percent). Very likely most of the Chesapeake Bay birds arrive by the Susquehanna route and the Delaware-New Jersey birds by the Delaware and lower Hudson routes. It seems reasonable to suppose that with the inland recoveries in the central and western parts of West Virginia, Virginia, and the Carolinas, and probably part of the southern coastal recoveries as well that many or most of these blacks arrived from the north by various inland routes. To a limited extent, these central New York blacks mingle with the New England and Mississippi flights but primarily they are affiliated with eastern Ontario and western Quebec birds in the north and with the Middle and South Atlantic populations to the south.

For the Rochester fall-banded ducks, the distribution of recoveries lies somewhere between the Montezuma records and those of Lake Scugog in Ontario. Direct recoveries from blacks banded before the hunting season total 71, of which 35 were taken locally. Using the indirect records (570), we find 20.6 percent taken in the New Jersey to Virginia region with only 5.4 percent on the New Jersey shore. The increase in the South Atlantic States from North Carolina south (8.0 percent) over that of the central New York stations (5.1) indicates the increased importance of western New York with the south Atlantic region. Very likely many of the blacks from western New York State reach these southern areas by interior routes to the west and south in the same manner as the southern Ontario black ducks. As was the case with the Ontario blacks, more Rochester-banded birds were recovered in South Carolina than in any other southeastern coastal state. The increase in southeastern recoveries is accompanied by a greater number of recoveries from the Mississippi Valley States: 9.6 percent as against 2.5 percent for the central stations. Generally speaking Ontario data from the South Atlantic States show twice the percentage of recoveries and from the Mississippi Flyway, two and a half times that recorded for the Rochester bandings.

Limited spring bandings (85 recoveries) show strong ties with the Middle and South Atlantic Coastal States from New Jersey south and with Ontario and western Quebec to the north. Winter bandings (103 recoveries) show somewhat the same distribution as fall and spring bandings except that recoveries outside New York to the south and west are at reduced percentages. The majority of the recoveries comes from New York State and the Canadian Provinces of Ontario and Quebec.

The most western New York stations, Niagara and Oak Orchard near the east end of Lake Erie, have too few records (total 87 recoveries) to give a proper ratio of recoveries between States. However, they are sufficient to give an indication that in this area we approach the point where equal numbers of recoveries are involved in the two flyways. The excessive local take of direct recoveries, 24 out of 36,

leaves relatively few records for analysis in both the Atlantic and Mississippi flyways. With the 38 indirects, we have 34 percent taken locally and 8 percent in Ontario. As for the Atlantic coastal and Mississippi Valley distribution, we find the recoveries about evenly divided.

Pennsylvania

In Pennsylvania, there are records from two stations, one at Pymatuning on the Pennsylvania-Ohio line and the other at the opposite end of the state near Reading.

Unfortunately, the number of recoveries (from both fall and spring bandings) for the Pymatuning Station are limited (95). Only 15 recoveries are available from bandings before the hunting season. The indirect recoveries are too few (69) to give a well-rounded distribution by states. But they give an indication of their relationship to the two flyways. Considering first the Atlantic Flyway States, we find 13 percent of the indirect recoveries from the segment Long Island to Virginia, with nearly half from Virginia alone. With the direct recoveries Virginia is the northern limit of Atlantic Coast records, so that very likely the Pymatuning birds have little influence on populations of the Atlantic Flyway from Maryland north. From North Carolina south, approximately 17 percent of the indirect recoveries are reported with the majority (13 percent) in South Carolina. If we include West Virginia, the total for the Atlantic Flyway is 32 percent, excluding 26 percent taken locally. The majority of the recoveries are from Virginia south. The 26 percent of the indirect recoveries from the Mississippi Flyway indicate a fairly even distribution between the two flyways. With the exception of one direct Florida record there are no Gulf Coast recoveries. In the Mississippi Flyway the southern limit of indirect recoveries is Mississippi and in the Atlantic Flyway, Georgia.

The Pymatuning blacks are strongly associated with Ontario in the north and to a lesser extent with western Quebec. There are no recoveries from the New England-Eastern Canada region.

Both spring and fall bandings have been carried out at the Reading Station. Approximately three-fourths of the recoveries (101) are from the spring series. Since only 8 direct recoveries from the fall bandings are available of which 6 were taken locally, the indirect recoveries from fall bandings (combined with those of the spring bandings) are the only usable records. These indirect recoveries show that the Reading station sampled a population from Ontario and western Quebec which was bound principally for the Chesapeake marshes of Maryland and Virginia. Grouped by regions the recoveries show 8 percent from New England and the Maritime Provinces; 26 percent from Long Island to Virginia (Maryland and Virginia accounting for 15 percent); and North and South Carolina have only slightly over 2 percent of the recoveries. Twelve percent and 10 percent of all indirect recoveries were from Quebec and Ontario respectively and about 30 percent were taken within 50 miles of the point of banding.

It is interesting to note that all of the Quebec records come from the spring-banded series, whereas Ontario is represented by both the fall and spring bandings. The Quebec recoveries are found well down the St. Lawrence to the Lake St. John and Saguenay River areas. Another interesting aspect is that all the New England recoveries are from spring-banded birds.

The Reading Station also shows a slight influence in the midwest with 3 percent of the recoveries coming from the Mississippi Flyway States of Wisconsin, Michigan and Ohio.

Summary - Northern Atlantic Flyway

There seems to be considerable variation in the data from station to station and from state to state. The greatest variability is the number of recoveries from the vicinity of the banding station. This in turn appears to influence the distribution away from the station.

1. From Labrador, eastern Quebec, the Maritime Provinces, and eastern New England, migration is primarily coastal, and goes as far south as Florida. In most years, it is not significant south of Virginia or coastal North Carolina. Not all of this northeastern population migrates south of New England; an important segment winters along the coast from Nova Scotia to Cape Cod.

The over-all flight pattern in the northeastern portion is somewhat confusing because some populations, like those in Quebec and Labrador, exhibit strong migrational characteristics, whereas, those banded on Massachusetts tidal marshes exhibit delayed movements or strongly sedentary habits. In the latter instance several factors might influence the populations concerned and cause bias in the data. Intensity of hunting, use of bait, extensive habitat, climate, and natural migration habits (or sedentary habits) are probably involved. The most important of these factors seems to be a marked trap selectivity where both sedentary and migrant populations are concerned.

2. Flights coming out of southern Quebec, Vermont, and eastern New York follow a north to south course through the Champlain and Hudson Valleys to the Delmarva Peninsula area and the Carolinas. These birds have limited affinities with the eastern Maritime areas as well as to the west in Ontario and westward.

3. Moving westward we find that with each change in degree (or degrees) of longitude, there is a shift in the axis or trend of movement from southeast to south and southwest. So that we find a progressive depletion of records in New Jersey and other Middle Atlantic States, and a corresponding build-up from the Carolinas south and in the Mississippi Flyway. Apparently a point is reached in western New

York and western Pennsylvania where the division between the Atlantic and Mississippi Flyways is about equal. For black ducks leaving southeastern Ontario for the southern wintering grounds, direct recoveries also are about evenly divided between the Mississippi Valley to the West and the Atlantic region to the south and east.

We now have a knowledge of the direction of movement southward from certain regions or localities. To complete the story for management purposes, a knowledge of the importance of the various migrant populations is necessary. At the present time there are relatively few data available which will aid in evaluating sizes of populations. Projects that will contribute data toward this end, would include (1) extensive breeding-ground surveys to determine population sizes, (2) increased banding, particularly on the northern breeding ground, and (3) extensive bandings on the wintering grounds. As for the breeding-ground program, studies are still in their infancy and it may take several years to obtain the required population data if it is at all possible to do so.

Southern Bandings

The data available from bandings on the southern wintering ground leave much to be desired, but do add a little more information on the movements of populations wintering in the Middle and South Atlantic States.

New Jersey

The reader will recall that flights coming out of the northeast showed recoveries largely restricted to coastal habitat in New Jersey, Delaware, Maryland, Virginia and in reduced numbers on to Florida. In this same region these blacks are joined by others coming out of the north and northwest. It would be expected therefore, that winter bandings on the eastern shore of New Jersey might show a greater proportion of recoveries the following year from the New England-Maritime Province area and that with similar bandings on coastal Virginia this proportion would change perhaps striking a balance in numbers between the northeastern and the northwestern group of recoveries. To check this assumption, we will examine the southern data. Unfortunately, for the Tuckahoe bandings on the east coast of New Jersey, there are practically no recoveries away from the immediate vicinity of the station. Even with the 21 indirect recoveries 18, or 85 percent are from the banding area. The remaining three taken outside the 50-mile radius are from Massachusetts, Ontario, and New Jersey.

Virginia

The next coastal station to the south is Chincoteague, Virginia. Below it, at the North Carolina line, is Back Bay, Virginia. Although Chincoteague records indicate a greater influence from the

northeast flight, these stations are combined here to show the general distribution trend for this east-shore population (fig. 14). All seasons of banding are included (mostly fall and winter) and only 74 indirect recoveries are available. Most of the 52 direct recoveries are from bandings during the shooting season and show recoveries into South Carolina and north to New Jersey. Over 80 percent of the direct recoveries are from the vicinity of the banding station.

To break down the indirect recoveries into terms consistent with the discussion of the northern banding stations they are divided into three groups (fig. 15): (1) Northeastern or Coastal Division, including eastern Quebec, Labrador, Newfoundland, Maritime Provinces, eastern New England and Long Island; (2) Central Division, taking in southern and western Quebec, Vermont, eastern New York (although Long Island is included with the northeastern group, a part of the Long Island records undoubtedly represents birds from the Champlain-Hudson route); (3) Northwestern Division, taking in Ontario, central and western New York, and any records farther west. The division between the Quebec and Ontario records is somewhat arbitrary for very likely some of the blacks in eastern Ontario follow the Lake Champlain-Hudson River route south. Likewise, some of the Quebec birds may travel the central New York route. The northeastern division, however, is fairly well defined. Recoveries from south of Long Island are not included because obviously, it is not possible to apportion these to the three northern regions. Breakdown of the recoveries for the three categories is:

Northeastern - 20 percent (Long Island 4 percent)
Central - 11 percent
Northwestern - 13 percent

This interesting distribution, too limited to warrant final conclusions, does indicate that black ducks migrating out of eastern Canada and eastern New England make a major contribution to the late fall and winter populations of the eastern shore of Virginia. Although these records indicate that nearly half of the migrant Virginia population is composed of northeastern birds, the potential variable involved in producing the distribution pattern is too great to warrant acceptance at this time. However, with these data in mind and the results from northern bandings we would expect that bandings on the eastern shore of New Jersey would show even greater affiliation with the northeastern coastal flight.

New Jersey - Delaware

Returning to the New Jersey data, we find a fair series of records (94) from bandings primarily during fall and spring at Carney's Point on the Delaware River. Only the 75 indirect recoveries are usable since the 19 directs are largely from bandings during the shooting season and mostly (75 percent) taken in the vicinity of the banding station. Likewise, for nearby Wilmington and Bombay Hook, Delaware, we

have a limited series (39) from bandings during the fall, winter and spring. Here again only the indirect recoveries (27) are of much use in showing distribution. Indirect recoveries from all seasons of banding are combined to show the distribution pattern. It is obvious that bandings during the fall and spring may show a somewhat different distribution than winter bandings, but until we have more records with which to work it is necessary to combine all the data.

From the northern banding data we would expect the Delaware River population to be affiliated more closely with the central north-ern division, with the northeastern showing a diminishing and the northwestern an increasing importance.

Breaking down the recoveries from the northern Delaware and western New Jersey stations into the same three categories as above we find:

Northeastern -	9 percent (Long Island 2 percent)
Central	- 16 percent
Northwestern -	9 percent

This tabulation indicates that nearly half of the Delaware River birds are derived from the country directly north in Quebec, Vermont, and the Hudson Valley, and that the northeastern and the northwestern flights may be about balanced. However, as mentioned previously, we are by no means justified in assuming that these per-centages show other than trends. The mapped recoveries indicate that the spring-banded population, which shows subsequent recoveries into North Carolina, probably influences the totals to some extent in favor of the northwestern division. The northwestern group has one far-western record, Minnesota.

Maryland

On the Eastern Shore of the Chesapeake Bay, most of the band-ing was done on the Blackwater Refuge primarily during the fall and spring. There are very few records of direct recoveries beyond the 50-mile radius. Of the 25 recoveries from bandings before the shooting season, 23 (92 percent) were killed locally. Even with the indirect recoveries amounting to 53, 62 percent were local recoveries. This leaves only 20 recoveries spread over a wide range to the north. A breakdown of the recoveries shows:

Northeastern -	2 percent (Long Island, 0)
Central	- 6 percent
Northwestern -	11 percent

The indicated distribution pattern is the same as that shown by northern bandings. The ratio between regions is probably far from accurate but nevertheless one can assume that for the eastern Chesapeake

area, flights coming out of central New York and Ontario are of greater importance than those traversing coastal New England.

To the west, bandings in the vicinity of Washington, D.C. give a limited series of 41 indirect recoveries including 21 taken locally. The remaining 20 are divided as follows:

Northeastern - 5 percent (all Long Island)
Central - 17 percent
Northwestern - 17 percent

As for the northeastern category, the only shooting records are from Long Island. They may not actually represent a northeastern population. Very little reliance is placed in these records as far as portraying actual distribution of the population. The banding has been very limited and scattered over a long period of years.

North Carolina

Most of the banding in North Carolina has been in the vicinity of the Mattamuskeet Refuge near New Holland. This location, though not on the extreme outer shores, is nevertheless in the zone of coastal tide-water. From this region we would expect a moderate reliance on flights from the northeast, but with the heaviest proportion coming out of the central and northwestern division. The 82 indirect recoveries are primarily from winter and spring bandings and fortunately only 12, or 22 percent, were taken locally. Breakdown by divisions shows:

Northeastern - 16 percent (Long Island, 0)
Central - 13 percent
Northwestern - 18 percent

This is a somewhat higher ratio for the northeastern than anticipated. As explained before, we know relatively little concerning the size of the various movements and the above may be more nearly right than we think. North Carolina's mapped recoveries support this. They show a funnel-like distribution (fig. 16). The western edge of the funnel is in the Lake Scugog area of southeastern Ontario and the eastern edge is in the Maritime Provinces and Newfoundland. Southward the western edge passes through central New York and Pennsylvania. Then the neck quickly narrows, and is restricted largely to New Jersey and the outer shores of Maryland, Delaware and Virginia. There is a scarcity of recoveries from the Chesapeake Bay area. New Jersey accounts for twice as many recoveries (18 percent) as any other state. This distribution of the recoveries indicates a much closer tie with northeastern populations than with populations to the west.

Apparently coastal North Carolina is not allied to a significant degree with the Mississippi Flyway. Only three records (4 percent) come from that region, including Kentucky, Michigan, and Manitoba. Incidentally, two recoveries in the eastern portion come from the far North at Ungava Bay.

South Carolina

The last important southern banding stations of the Atlantic Flyway are in South Carolina. About 80 percent of the recoveries come from bandings at Brookgreen Garden near the coast and the rest from inland areas, near Oakley and the Santee Refuge. One hundred and twenty indirect recoveries are available of which 23, or 19 percent, were taken locally.

A glance at the mapped recoveries (fig. 17) shows a strong westward distribution from the Carolinas and the Middle Atlantic area northwest through the Great Lakes region.

When we separate the northern records into the three divisional categories we find:

Northeastern -	7 percent (Long Island, 1 percent)
Central -	3 percent
Northwestern -	38 percent

The northwestern category might be broken down into the Ontario-New York-Pennsylvania group which accounts for 23 percent of the records and the far western states and provinces of Manitoba, Minnesota, Wisconsin, Michigan, and Ohio which account for 15 percent. This demonstrates that populations wintering in eastern South Carolina are primarily concerned with the country to the north and northwest — from New York and Ontario to Minnesota and Manitoba. Apparently the influence of the northeastern flights is strong as far south as Pamlico Sound but declines rapidly below that point. This seems to be true also for flights coming out of the central area which includes southwestern Quebec, Vermont, and eastern New York.

General Summary - Atlantic Flyway

The important bandings within the Atlantic Flyway and in Canada from Ontario to Newfoundland have been considered. The broad patterns of migration appear to be as follows:

1. Black ducks coming out of Labrador, eastern Quebec, Newfoundland, the Maritime Provinces, and eastern New England follow the coastal route southward, making important contributions to coastal populations from Nova Scotia to the vicinity of Pamlico Sound, North Carolina.

2. An intermediate group from or enroute through southwestern Quebec, northern Vermont, and eastern New York fly largely in a north-to-south direction along the Champlain-Hudson Valleys, thence through New Jersey, eastern Maryland, and eastern Virginia to Pamlico Sound. These birds mix with the northeastern group primarily along the outer coastal bays from Long Island and New Jersey south. A segment of this troupe, apparently a minor portion, contributes to the Mississippi Flyway.

3. Recoveries from birds banded at points in southeastern Ontario and western New York present a complex pattern showing birds going into the Mississippi Flyway, the South Atlantic, and the Middle Atlantic States.

From southeastern Ontario an east-bound flight crosses western and central New York and central and eastern Pennsylvania, thence through the Middle Atlantic States to the Carolinas and Florida. In the Middle Atlantic Region the Chesapeake Bay marshes are of major importance to the northwestern birds while the outer shores of New Jersey, Delaware and Maryland are of lesser importance. Apparently most of the black ducks taken on the west shore of the Bay in Maryland and Virginia come out of the northwest.

Ontario blacks bound for the South Atlantic region apparently travel inland as well as along the coast. Blacks in the South Atlantic States from South Carolina southward are made up largely of birds from or passing through Ontario, New York and Western Pennsylvania and west through the Great Lakes Region.

Western Bandings

Ohio

At various times in Ohio during the past 10 or 12 years, five stations have been in operation, spotted across the state from Erie to Celina. Only Ashland, located in the north-central part of the state, has enough records to give a reasonably fair distribution. However, the heavy take in the vicinity of the banding station accounts for a major share of the recoveries. Most of the banding was done during the hunting season, and of the 63 direct recoveries 65 percent were taken locally and 78 percent within Ohio itself.

The mapped recoveries from all Ohio stations show a spread of records throughout most of Ontario and the states east of the Mississippi to New York. Bandings in northeastern Ohio show important affinities for the southeastern Atlantic States as well as the Mississippi Valley States. The western Ohio station (Celina) indicates little contribution to the Atlantic Flyway. However, as will be demonstrated later, black ducks migrating to the southeastern coastal states from out of the northwest probably travel through most of Ohio.

Indirect recoveries (210) from the Ashland station show the bulk of the recoveries were taken from Ohio northward. Fifty-six percent of the recoveries were taken within Ohio. This situation, showing limited southward movement and heavy local kill approaches that found along the southern New England coast and certain inland areas in New York, Pennsylvania, and Michigan (to be discussed).

Based on the number of recoveries from one region as against another, the principal supply of Ohio black ducks is derived from birds originating in or passing through Ontario, western Quebec, western New York, and western Pennsylvania. From earlier discussions of bandings within this region to the north and east it was noted that a significant portion migrated to Ohio and beyond. Farther west, from Michigan to Minnesota and Manitoba, 8 percent of the recoveries were taken as compared to 19 percent from the north and northeast, so that the principal movement into Ohio is from the north and northeast.

Recoveries south of the Ashland station are difficult to interpret. Apparently migration is relatively slow or delayed and most of the records are from scattered inland points. From the Ashland station there is a fanning out over a broad front from the State of Mississippi east to the Carolinas with South Carolina accounting for more than half (4 percent) of the South Atlantic indirect recoveries. Interior recoveries indicate no particular major routes of travel but a general overland movement following many devious courses. With indirect recoveries it is uncertain what route was followed in some instances. This is particularly true of the few Middle-Atlantic recoveries from New Jersey to Virginia.

Indiana

Bandings in Indiana have been at two widely-separated locations, one at Rensselaer in the north just below Lake Michigan and the other at the southern tip of the state on the Ohio River in Posey County. The Rensselaer bandings are the more numerous, but neither station has banding of sufficient scope to give an adequate distribution. The banding was done primarily in the fall during the hunting season and to a very limited extent in the spring at Rensselaer.

The pattern displayed by the Rensselaer distribution (54 indirect) is much like that of Ashland, Ohio, except that there is a shift westward. At the most, about 3 percent of the recoveries could be considered as within the Atlantic Flyway. The northern records extend from eastern Ontario to Minnesota with Ontario accounting for 11 percent, and the Michigan-to-Minnesota region 20 percent of the indirect recoveries. South of the station the flow of movement is primarily south and west through the Ohio and Mississippi Valleys with some birds reaching Texas and Alabama.

The Hovey Lake records (30 indirect) show a closer association with the Michigan-to-Minnesota region with 40 percent of the recoveries as compared to Ontario with 7 percent. With so few records scattered over such a wide area it would be inadvisable to place too much reliance on these ratios.

Illinois

Extensive banding operations have been undertaken in Illinois at Orland Park near Lake Michigan and at the Chautauqua Refuge on the Illinois River. Of considerably lesser magnitude are records from Savannah in the northwestern part of the state and from Grafton in the southwestern.

The Orland Park operations have produced a total of 957 recoveries most of which are from bandings during the hunting season. One hundred and forty-six direct recoveries are available from bandings before the shooting season and all directs total 439. The indirect recoveries total 518. Of the direct recoveries from bandings prior to the hunting season 50 percent were taken locally (62 percent for all directs) and of the indirect recoveries 30 percent were recovered locally. Actually 72 percent of the direct recoveries and 47 percent of the indirect recoveries were taken within Illinois.

Direct movement from Orland Park (from birds banded before the hunting season) assumes an expanding cone-shaped pattern spreading southward with most of the recoveries in the lower Mississippi Valley and a scattering to the southeast in the Carolinas (fig. 18). Using directs from hunting season bandings (293) also, there is shown a relatively heavy concentration of records along the Illinois River indicating the Illinois Valley as an important route followed by the Orland Park birds bound for the lower Mississippi River area.

The indirect records show much the same pattern southward and in addition show a heavy concentration of recoveries to the north and northwest (fig. 19). The Wisconsin-Minnesota-Manitoba area accounts for 16 percent of the recoveries and the Michigan-Ontario region to the northeast, 13 percent. Ontario accounts for 5 percent, and the eastern states from Virginia to New York, 2 percent. Just what some of these records represent is problematic, particularly the southeastern Ontario recoveries. The Orland Park area is obviously a crossing point for some blacks bound for the middle eastern states from the west and for birds bound for the Mississippi Valley from the east. Data from this station as well as from the eastern bandings indicate the movement into the Middle Atlantic area from the mid-west as relatively minor, whereas the movement from Ontario and northern New York to the southwest is probably of greater magnitude.

Perhaps a breakdown of indirect recoveries by divisions (fig. 20) would be clarifying:

Local	- 30 percent
Other Illinois	- 17 percent
Ontario	- 5 percent
Michigan	- 8 percent
Northwest	- 16 percent
Western	- trace
Mississippi	- 20 percent
So. Atlantic	- 1 percent
Middle Atlantic	- 2 percent

It is possible that a local wintering population may be influencing the distribution of recoveries but if so apparently not to the same degree as on the coast.

The Chautauqua recoveries total 337 indirects and 175 directs of which only 6 are from bandings prior to the shooting season. Over 60 percent of the direct recoveries were taken locally. The distribution is much the same as that of Orland Park except that there is a reduced percentage (0.29) taken in the middle Atlantic States, and there is a stronger affinity for the Illinois-Mississippi River systems. This would be expected since the station is located over 100 miles southwest of the Chicago area on the Illinois River. The general population movement is from North and Northeast to South and Southwest. The breakdown of the indirect recoveries into divisions is as follows:

Local	- 31 percent
Other Illinois	- 12 percent
Ontario & Quebec	- 5 percent
Michigan	- 7 percent
Northwest	- 22 percent
Western	- 2 percent
Mississippi	- 19 percent
South Atlantic	- 1 percent
Middle Atlantic	- trace

For the Spring Lake station there are only 43 indirect and 32 direct recoveries of which only 9 are from bandings before the shooting season. Approximately 59 percent of the direct recoveries and 30 percent of the indirects are from the vicinity of the banding station.

Noteworthy is a lack of any indirect recoveries from Ontario. The majority of the northern recoveries (18 percent) comes from the territory, Wisconsin to Manitoba. The importance of Michigan with 2 percent is less than that of the other two stations as would be expected from the location of the station.

The 27 recoveries from spring bandings at Chautauqua and Orland Park show a southern distribution entirely east of the Mississippi River and no recoveries in the Atlantic states. Wisconsin and Michigan account for most (15 percent) of the northern recoveries. Ontario has one record (4 percent).

Michigan

Michigan ranks third in number of recoveries on file at the Patuxent Refuge with a total of 2,730. Commencing with the Upper Peninsula, we have Munuscong at the eastern tip and Seney near the center of the Peninsula some 80 miles to the west. These two stations account for 868 and 662 recoveries from fall bandings, respectively.

One would assume that the pattern of distribution would be much the same from these two stations. However, there appears to be enough difference between the two in the shift in the distribution of their recoveries in an east-west direction to warrant separate consideration. A comparison by divisions following the same breakdown as before would illustrate the difference in pattern between northern stations separated in an east-west direction by a relatively few miles (also see p. 44).

<u>Area of Recovery</u>	<u>Direct Recoveries</u>	
	Percent of Recoveries for Seney (274)	Munuscong (368)
Local	24	22
Other Michigan	6	19
Ontario	3	12
Northwest	11	6
Western	2	-
Mississippi	47	31
South Atlantic	5	3
Middle Atlantic	1	5

Following the same categories the indirect recoveries tally as follows:

<u>Area of Recovery</u>	<u>Indirect Recoveries</u>	
	Percent of Recoveries for Seney (265)	Munuscong (302)
Local	5	12
Other Michigan	16	19
Ontario	7	13*
Northwest	12	3
Western	1	tr.
Mississippi	50	35
South Atlantic	2	10
Middle Atlantic	7**	8

*Includes Quebec

**Includes Long Island and Connecticut

These northern bandings conform to other northern bandings in that there is a strong migration to the Gulf Coast and to the Atlantic Coast. The mapped recoveries from bandings on the northern peninsula (fig. 21) show a distribution covering much of the range of the species. The direct recoveries show a rapidly expanding cone-shaped pattern with many overland routes taking the birds throughout much of eastern United States from the edge of the Great Plains to the Middle Atlantic States. These records show again the complex nature of black duck movements throughout the country.

A limited series (71) of recoveries from spring-banded birds at Munuscong show an interesting distribution with relatively strong affinities with the Atlantic States.

Local	- 3 percent
Other Michigan	- 11 percent
Ontario	- 14 percent
Northwest	- 6 percent
Western	- 3 percent
Mississippi	- 34 percent
South Atlantic	- 18 percent
Middle Atlantic	- 11 percent*

*Includes Long Island

Considerable banding has been done at scattered points in the Lower Peninsula with the bulk of the operations centering around the Battle Creek-Lansing vicinity in the south-central portion. There is a total of 799 recoveries from fall bandings in the Battle Creek-Lansing area, 109 for the Detroit area and 31 for Muskegon.

These Michigan data indicate a similarity to data from coastal wintering areas of Massachusetts and at other points in the northern states where heavy hunting pressure and wintering populations exist.

In both areas we have a heavy local recovery, indications of a population with strongly sedentary habits, and a limited number of recoveries in the south. Here, again, the evidence indicates that when we have a heavy hunting pressure and the beginning of a wintering population or a group of birds that will not move on until very late, banding does not adequately sample the migrant population. In other words, to evaluate properly migration or movements on a broad scale we must have data from far northern stations as well as intermediate and wintering ground areas.

For comparison with the Northern Peninsula stations a breakdown of the recoveries from fall banding in the same manner as before for the Battle Creek-Lansing area may be of help.

Area of Recovery	Percent of Recoveries	
	Direct (138)	Indirect (515)
Local	70	47
Other Michigan	17	17
Ontario	1	7*
Northwest	2	9
Western	-	-
Mississippi	8	14
South Atlantic	-	2
Middle Atlantic	1	3

*Includes Quebec

Here we see that of the direct recoveries from those banded prior to the hunting season only 9 percent were taken south of Michigan and of the indirects, 19 percent. The wide southward dispersal pattern of the Lower Peninsula birds is much the same as that of the northern birds except that it is much reduced and there is a greater tendency for the birds to remain farther north, or at least not to show the urgency for a rapid and deep penetration southward (fig. 22). It will be recalled that much the same was said of the distribution for coastal bandings in Massachusetts and to a varying degree of certain other inland areas.

In his discussion of the Michigan records Pirnie (1935) points out:

1. Records from the Kellogg Sanctuary show a spread somewhat similar to that of the Munuscong bandings except that the Kellogg birds do not seem to go as far south.
2. The Kellogg blacks winter farther north than the northern birds.
3. Some are probably permanent residents being retrapped nearly the year-around.
4. The majority migrate to the Mississippi Valley with smaller numbers going to the Atlantic Coast.

Recoveries from fall bandings at Muskegon and Detroit are too limited in number to compare with the other Michigan stations. Much the same situation exists, however, in that there is a relatively heavy local take (70 to 80 percent) and relatively few southward recoveries.

A limited series of records from spring bandings at Detroit (19), Battle Creek (47) and Muskegon (8) shows somewhat the same distribution as fall bandings except that there is a higher percentage of

far southern records. Over 80 percent of the recoveries from spring banding at Detroit come from within 50 miles of the banding station. This is a considerably higher percentage of local recovery than that recorded for spring bandings on New England coastal areas.

A series of 115 recoveries from winter bandings in the Detroit area present somewhat the same or a more restricted pattern as the fall bandings. Here only 12 percent were taken south of Michigan including about 3 percent from the South Atlantic states.

Wisconsin

Bandings in Wisconsin have been quite limited. The northernmost of importance is the Green Bay area near Suamico with 165 recoveries, Campbellsport and the Horicon Refuge about 70 miles to the south with 141 records, and Necedah Refuge about 85 miles westward with only 16 recoveries. Since the records are somewhat limited for any one station they have been combined. Actually there is not much difference in the overall distribution. The largest variable, and the one that influences all the records, is the percentage taken locally. At all the stations the first-season direct recoveries from around the banding station total 65 to 71 percent. With the indirects there is a wider range, from 10 percent at Suamico in the north to 30 percent at Horicon in the south.

The pattern of direct recoveries is confined almost wholly within States bordering the Mississippi River. Much the same is true of the indirect recoveries, except that the Atlantic Flyway States and Alabama are involved to a limited degree. Records from the more northerly station at Green Bay exhibit a little more of a tendency for deeper southern penetration, particularly with the first-season directs.

A breakdown of regional divisions for all indirect and direct recoveries banded prior to the shooting season is as follows:

Area of Recovery	Percent of Recoveries	
	Direct (85)	Indirect (102)
Local	67	21
Other Wisconsin	7	18
Ontario	-	5*
Michigan	2	7
Northwest	2	2
Western	1	2
Mississippi	20	41
South Atlantic	-	1
Middle Atlantic	-	4**

*Includes Quebec

**Includes New York

Compared to the Michigan and Ontario stations, the distribution of direct recoveries from Wisconsin are much more closely grouped, following principally the Mississippi River system.

This completes the discussion of the more important black-duck bandings throughout the United States and Canada. Black ducks have been banded from time to time in a number of other states and provinces but the number of recoveries available are too few from any one state to warrant discussion at this time.

General Summary - Mississippi Flyway

And now a brief summary of what the data seem to show regarding movements of the black duck from various points in the Mississippi Flyway.

1. Although the pattern of movement throughout the interior is extremely complex the bulk of the recoveries from blacks banded in the Flyway are taken within the Flyway.

2. The crossing-over of Atlantic-Flyway and Mississippi-Flyway populations, though occurring to some extent all along their common boundary, seems to be of greater significance in the southeastern region including the states from South Carolina to Florida. Recoveries from blacks banded in these states and birds taken in this region from bandings elsewhere indicate nearly as strong a tie with the Mississippi Flyway as with the Atlantic Flyway.

3. The complex nature of the interior movements is indicated by the wide cone-shaped spread of recoveries from individual stations particularly those located in the northern states and in Ontario. From northern stations the black ducks appear to move over a broad front with individual birds or groups of birds following certain valleys, river courses, or other features and other blacks possibly striking overland to cross drainages and mountains. In this situation some groups of birds probably cross at nearly right angles the paths of others during the southward movement.

4. The Mississippi Flyway is concerned with blacks originating within its boundaries, as well as some populations originating in or passing through western Pennsylvania, western New York, southwestern Quebec, and all of Ontario.

Time of Migration

We have discussed at some length the routes taken by black ducks during their fall migration and without a knowledge of the numbers of birds involved, have attempted to arrive at a rough approximation of the relative importance to particular regions of certain major groups.

It has been pointed out that the distribution of recoveries, as mapped and tabulated, may or may not represent the true behavior of the population. Some of the more important factors causing distortions in the data are variations in hunting pressure, the time of hunting, habitat distribution, climate, whether both wintering and migratory populations are involved, and the method of trapping. There are relatively few data available that will give us a measure of the impact of these influences on populations or on the resulting recovery of shooting records.

An important behavior pattern of the species which has a bearing on whether a representative series of a migratory population is being banded and shot, is the time and extent of migration. With some bandings the time of migration is rather difficult to determine. However, with certain of the northern stations, in which a substantial number of direct recoveries from early fall bandings are available, we can derive considerable information. The northeastern coastal flights lend themselves well to this analysis since the population moves south along a restricted course from state to state and does not spread widely over the country.

The accompanying charts (figs. 23-31) present the data more lucidly perhaps than involved discussions. The explanation of the chart is as follows:

(a) Across the top the fall season is divided into periods of approximately 10 days.

(b) Down the left-hand margin the provinces and states are listed, beginning with the northernmost and following consecutively to the southernmost in which recoveries were taken.

(c) Recoveries are shown under the 10-day period and the state or province in which they were taken. The number of black units represents the number of recoveries in each period.

(d) The heavy line indicates the overall span of the hunting season in each state or province during the years in which banding took place.

By arranging the data in this manner the approximate arrival date for some flights can be determined. Banding data and hunter-bag checks indicate that in recent years a third to a half of the kill is made the first 3 or 4 days of the season so that if banded birds are in an area the probability is high that some of these birds will be taken during the opening period of the season. It is likely, too, that new migrants are more easily taken immediately after arrival than later when the birds have learned to avoid the gun.

Before launching into the discussion on population movements it should be emphasized that the discussions which follow are based only on existing banding data. Some of these data are limited in volume, were obtained over 20 years ago, and in recent years the wide variation between states in length and time of the open season has left potential gaps in the recovery pattern. It is expected that with more banding in the north, particularly in Canada, the additional recovery data will indicate annual variations in time and extent of movement and will eventually permit a more complete and accurate story than that which is given here.

Commencing with bandings in eastern Quebec (fig. 23) we see that there is an early movement into the Maritime Provinces and eastern Maine. Just how early these birds arrive is not certain but at least they are in the Maritime Provinces during the first days of October. Very likely the vanguard arrives the latter part of September, and the movement continues throughout the fall. Apparently, eastern Maine and Nova Scotia represent the farthest southward penetration of this first movement, because the Massachusetts gunners do not begin to shoot these Quebec birds until early December even though the season has been open for several weeks or months. This distribution of recoveries in Massachusetts may not be typical because all but one of the 1947-1950 hunting seasons were split, thus creating a situation in which the chances of getting recoveries in Massachusetts during the middle and latter part of November were much reduced. However, during the middle of the fall period part of the Quebec birds take flight and head apparently non-stop, for Long Island, New Jersey, and other southern coastal areas, passing by all southern New England. The vanguard of this flight probably arrives in New Jersey during the first or second week of November or possibly in late October, and the spread of the recoveries indicates that very likely such flights continue throughout the fall period. At any rate, we have a situation in which some of the Quebec black ducks are in southern Jersey at least 3 weeks before the Quebec birds are taken in numbers in Massachusetts. The Quebec blacks apparently arrive in Virginia and the Carolinas about the same time they are first taken in numbers in Massachusetts. These far southern records may represent long flights from the northern coast as well as shifts from New Jersey and other Middle Atlantic areas. It would seem that the movement of the Quebec birds continues along the coast throughout most of November and December.

The timing of recoveries from the Tinker Harbor, Labrador, station (fig. 24), appears to be more erratic but this may be the result largely of a lack of a sufficient volume of records. However, some of the Labrador birds seem to fly over the Maritime Provinces and fill gaps in southern New England not occupied by the Quebec birds during the middle of the fall period. The earliest record in Massachusetts for these far northern blacks is at the opening of the season around the middle of October. Perhaps these migrants were actually on Massachusetts waters early in October. The Labrador blacks are in the New Jersey to Carolina area about the same time as the Quebec birds.

The Newfoundland black ducks do not migrate even into the Maritimes until late (fig. 25). The Labrador and Quebec blacks have been in Nova Scotia a full month or more before the first of the Newfoundland birds are taken in November. This recovery pattern may be influenced by the fact that the hunting season in the extreme southern counties of Nova Scotia does not open until about the middle of November. The movement into New England is somewhat later. The Newfoundland birds apparently arrive at about the same time (early December) all along the New England coast. There are some earlier flights to the Middle Atlantic area which coincide with the invasion of Nova Scotia in November but which by-pass New England.

There are enough records from bandings before the hunting season on the Penobscot River in Maine to show a fair distribution. In figure 26, recoveries within a 50-mile radius of the banding station are not included. The movements of these Maine birds seem to be more casual than those of the far northern bandings. The first movements are into southern Maine in early October and into Massachusetts the latter part of the month. There is a gradual movement down the coast, very likely with some groups moving by numerous short flights, and others making somewhat longer flights passing over the others. The Maine birds arrive in the Connecticut-New Jersey area in early November and in the Virginia-South Carolina area the latter part of November. From our previous discussions the Labrador, Quebec, Maine, and to some extent the Newfoundland, birds all take the same general coastal route in their fall migration.

The limited series of records from the northern Lake Champlain stations (fig. 27) indicate that some of the population moves southward relatively early, being in eastern New York at least by the middle of October. The main flight into the southern states probably does not get underway until about the middle of November. The first birds from Vermont are taken in New Jersey during the same period (about the middle of November) as the northern coastal black ducks. Apparently most of this November movement makes the flight to New Jersey and southward in one hop relatively few birds stopping enroute in southern Vermont, New York, and southwestern New England.

Figure 28 segregates the Lake Scugog early fall (August and September) bandings into two groups, the Atlantic Flyway states first and beginning with Ohio the Mississippi Flyway states. Quite early in the fall the Scugog blacks spread out through southern Ontario and southwest through northern Ohio and by the middle of October are in eastern Michigan. At this same time there is movement also southeast, probably directly across New York and Pennsylvania to the New Jersey-Maryland area. This latter migration is probably of minor proportions compared to later flights in November. The latter part of October the southwestern migration continues on from western Lake Erie probably across northern Indiana to the central Mississippi and Illinois River Valleys in Illinois and Missouri. At about this same time or perhaps

a little later (early November) the main migrations into the South and Middle Atlantic States get under way. The first of these migrations from Ontario, particularly to the South Atlantic States, are apparently 2 to 3 weeks earlier than the flights from eastern or Maritime Canada and eastern Maine. As for the southwestern movement, the Ontario black ducks work their way south into Tennessee, Arkansas and northern Alabama during the second half of November and apparently do not reach the lower Mississippi and Gulf Coast until the first or middle part of December. These far southern records probably represent a gradual migration as well as relatively long direct flights from the northern states.

The data for Seney and Munuscong on the Upper Peninsula of Michigan have been recorded separately in figures 29 and 30. Perhaps these two stations might logically be combined but the difference in trend and time of movement would seem to warrant separation, at least from an academic point of view.

The early fall movements into the northern states is more noticeable with the Munuscong birds. These blacks move into the Lower Peninsula and into Wisconsin 10 days to 3 weeks in advance of the Seney population. This is remarkable in that some of the Munuscong blacks on their way west to Wisconsin, undoubtedly, pass near Seney. Some of the Seney blacks moving south and east through the Lower Peninsula eventually overtake the Munuscong birds in Ohio (Lake Erie), but even here the main flight of the latter arrives about 10 days to two weeks ahead of the Seney birds which do not begin to increase in number until about the middle of November. In like manner the westerly movement through eastern Wisconsin arrives in force in Illinois by early October, keeping the 2 to 3 week's lead over the Seney blacks.

Both populations apparently begin to leave the northern states for the lower Mississippi and Gulf Coast States about the same time arriving in the southland around the middle of November. From the data it would seem that much of the Seney population skips over the intervening states of Kentucky and Tennessee, whereas these areas seem to be important stopping places for the Munuscong black ducks.

At the same time these populations arrive in the Gulf Coast States, part of the Munuscong population is being taken also in the Middle Atlantic States, particularly Virginia. The invasion of the South Atlantic States probably starts about the same time, though the evidence is that most of them arrive in December with the peak for the Munuscong blacks about 10 days to 2 weeks ahead of the Seney birds.

Figure 31 shows the distribution of a limited series from Orland Park, Illinois, banded in August, September, and early October. Although there is some early October drifting into Indiana and southwest through Illinois these blacks do not seem to exhibit any pronounced movements until early December. Black ducks from the Upper Peninsula of Michigan have been in the Southern states 2 to 3 weeks

before the Illinois birds arrive. Very likely many of these blacks reach the Southern States by a somewhat casual manner of migration. This is another illustration in which the far northern birds pass by others of a more sedentary nature and arrive far to the south long before the more intermediate populations begin to move. This same condition holds to an even greater degree for black ducks banded in the Lower Peninsula of Michigan where the bandings show a strongly sedentary population, which moves reluctantly south but a relatively short distance, and does not indicate the same degree of migration as ducks from the north passing through. The analogy seems to be applicable across most of the northern states as far as the east coast of New England and perhaps to the Maritime Provinces of Canada.

So we find that the time or period of migration is considerably involved and varies markedly from one section of the country to the other. Generally speaking, direct recoveries show that many of the far-northern birds exhibit a strong migratory habit, resorting to relatively long flights and penetrate deep into the South; other groups, particularly those that accumulate in late summer and early fall in the vicinity of potential wintering habitat in the northern states, form rather sedentary habits and are reluctant to move until freeze-up, if at all. There is probably a considerable amount of casual migration and "leap-frogging" with one population passing over another. As a general rule, migrations into the southern Atlantic Coastal states from the interior areas of Ontario take place 10 days to 3 weeks earlier than those from eastern Maritime Canada.

SUMMARY AND CONCLUSIONS

1. The report concerns the fall movements, or migrations, of the black duck throughout its range as revealed by banding records. A total of 15,481 recoveries, made during the hunting season and on file at the Patuxent Research Refuge, have been analyzed. These records of recovery were obtained between 1918, when banding first started, and January 31, 1951.

2. The Atlantic Flyway receives its black ducks from the vast territory bounded on the east by Labrador and Newfoundland and on the west by Ontario and Wisconsin. The Mississippi Flyway draws its birds from Ontario and western Quebec, the northern states within its flyway boundaries, plus western Pennsylvania, and New York. As a result we find some black ducks from northeastern states traveling southwest into the Mississippi Valley and some blacks from the states of the north central region and Ontario moving southeast to the Atlantic States.

The interchange between flyways is probably of little importance in management since the majority of the birds banded in a flyway are taken in the same flyway. The region not conforming entirely in this respect includes the South Atlantic states from South Carolina to Florida. Bandings from this region seem to show nearly as strong an affiliation with the Mississippi Flyway as with the Atlantic Flyway.

Flights out of eastern Canada and eastern New England travel in a southerly or southwesterly direction. Recoveries are confined largely to coastal areas. Important numbers go as far south as North Carolina. Those birds banded in northern Vermont and eastern New York continue southward to the coastal areas of the Middle Atlantic states and a number of records come from the Delaware and Chesapeake Bay marshes. From western New York and Ontario, the southward pattern of dispersal takes on the aspect of a rapidly expanding cone. The birds go into the Mississippi Valley as well as into the Middle and South Atlantic states. Further westward in Ohio and beyond, the axis of migration is south and southwest with the Middle Atlantic states rapidly decreasing in importance.

3. At many points in the northern states from coastal Massachusetts to Wisconsin, as well as in parts of maritime Canada, banding records indicate the existence of some populations with more or less sedentary habits. Lack of movement or possibly delayed migration seems to vary somewhat between areas but generally 60 to 80 percent of the direct or first-season recoveries are taken within a 50-mile radius of the banding station, and frequently a large part of the remainder are taken not much farther south. This is in striking contrast to the bandings farther north. These northern bandings indicate a strong movement through or over these intermediate areas, and a penetration far to the south.

It is believed that the nucleus of this sedentary group of birds is composed of individuals that in the early fall established wintering-ground behavior patterns. If bait traps are in operation, these birds monopolize them to the exclusion or partial exclusion of the transient population. Fall bait-trapping in areas where there are both wintering and transient populations does not, therefore, sample the over-all population in a representative manner. The trapping records will show a strong bias in favor of the wintering or sedentary population.

In some areas, northern Lake Champlain for instance, a heavy "take" of black ducks in the vicinity of the banding station is not linked as strongly to a wintering population. This take may be influenced by --

- a. Excessive shooting.
- b. Habitat from which it is hard to drive the birds.
- c. Natural habit of the birds to linger until late in the season.
- d. Trap baiting that induces the birds to remain in the area longer than is normal.

4. The time of movement from northern stations shows that some early flights of black ducks move quite long distances to southern areas, skipping intervening states. For example, some coastwise migrants from eastern Canada arrive in the Middle Atlantic area nearly a month earlier than birds from the same banding station arrive in southern New England. Populations from other areas fill in the gaps left. Such flights result in a leap-frog pattern of movement. Although important movements into the Middle Atlantic states take place about the middle of November, there are some groups such as those from Newfoundland that do not move in any appreciable numbers until December.

Flights from northern interior points, particularly Ontario, disperse into the northern states early in October. During the latter part of October and early November the main southward movement of the Ontario black ducks gets under way, bringing the first of these birds into the South Atlantic states from 10 days to 3 weeks ahead of the northeastern blacks. Birds from these same bandings do not arrive on the Gulf Coast until the middle or latter part of December. Interior stations also appear to differ as to the time the important movements take place.

5. Additional banding needed and studies that would furnish important information for use in interpreting banding data are:

- a. An expanded banding program on the southern wintering grounds, at least from New Jersey south and in the wintering areas of the Mississippi Valley, to determine by indirect recoveries the origin of the winter populations on the wintering grounds would be necessary.

- b. Improved or expanded breeding-ground coverage in the United States and Canada to determine the size and distribution of breeding populations.
- c. A corollary to "b" is expanded banding on the breeding grounds to determine the similarity and variance in the migrational characteristics of birds from different areas.
- d. In view of the important differences in the movements between ages and sexes as found in other species, it is recommended that all future black-duck bandings include accurate records of sex and age.

APPENDIX

Additional Data from 1951 Bandings

The report summarizes banding recovery data available through January 1951. Since the preparation of the manuscript the author has had an opportunity to tabulate and summarize the records received during 1951 and to the spring of 1952.

These additional records total 2,037 recoveries from shooting; among them are 278 from bandings in Canada. Bandings from 26 states and 8 Provinces are included with those from Quebec, Maine, Massachusetts, Connecticut, New York, Wisconsin, Michigan and Illinois, accounting for more than half the recoveries. From bandings in the United States, there are 736 direct recoveries of which 533 were banded 5 days or more before the hunting season.

A detailed breakdown by percentage of recovery for various states and regions will not be given here. It will suffice to say that the patterns of movement shown conform closely to those presented in the first section of this report and strongly reinforce the statements and conclusions made.

Most of the new records concern stations for which there were already fairly voluminous data available. There are, however, a few instances in which new banding localities are involved.

There is a series of 39 direct recoveries from bandings during 1951 at Castalia, Erie County, Ohio. These records, though relatively small in number, show much the same pattern as those from stations in southern Michigan, coastal Massachusetts, and others in the northern states where the bulk of the recoveries are taken in the vicinity of the banding station and the remainder exhibit only a limited movement southward. Among all direct recoveries, 85 percent were taken within 50 miles of the banding station, and only 3 or 4 records were taken from south of Ohio, Tennessee, South Carolina, Virginia, and Pennsylvania account for one record each. Eighty percent of the recoveries from bandings prior to the hunting season (30 in all) were taken locally.

These records add another bit of confirming evidence to the already voluminous data in the report and they support the proposition that, in certain areas of the northern states where some birds tend to linger late in the season, or when they establish winter territories in areas of heavy shooting, trapping in the fall at these points does not sample, in a representative manner, all populations concerned. There is a strong tendency for the more sedentary population to be trapped to the exclusion of the transient or migratory population.

Eighty-two direct recoveries from bandings at Sorel, Quebec, at the head of Lake St. Peter, conform in distribution a little more closely to those from bandings in central New York rather than to those from the Lake Champlain bandings. With the Sorel records Maryland accounts for the largest unit of southward recoveries totaling 13.4 percent. New Jersey ranks second with 8.5 percent. Inasmuch as Sorel is located about 75 miles directly north of Lake Champlain it would be expected that the pattern of distribution from the two areas might be similar. However, there seems to be a relatively stronger affiliation with the Chesapeake Bay area than is true with the Lake Champlain bandings. Very likely many of the Sorel black ducks move up the St. Lawrence River to Lake Ontario and thence south across New York and Pennsylvania. In the Atlantic Coastal states all but one record (Florida) occurs from North Carolina north. There are three direct recoveries in the Mississippi Valley (3.6 percent) including Illinois 2, and Arkansas 1. Recoveries from within 50 miles of the point of banding totaled 41 or 50 percent.

Seventeen indirect recoveries from the 1950 bandings at Moosonee, Ontario indicate a more important relationship with the Mississippi Valley than is shown from the direct recoveries. Thirteen of the recoveries were taken within the United States and of these 5 and 8 are from Atlantic Flyway and Mississippi Flyway states, respectively.

With few exceptions the direct recoveries from the 1951 bandings follow the same pattern of time of movement as that portrayed in the section "Time of Migration". As would be expected, there is some variation particularly in regard to earliest arrival date. Bandings from the Baie Johan Beetz station (totaling 41 recoveries) show one black duck as being taken in the Cape Cod area of Massachusetts on October 26. This record is largely atypical of other recoveries from Massachusetts, which show that the first and important take of the Quebec banded birds is in early December. However, Massachusetts has had a series of split hunting seasons which may be limiting the take of earlier recoveries. Further banding will, undoubtedly, clarify this point. Perhaps there is some relationship between the Massachusetts October recovery and the recovery of a Baie Johan Beetz black duck taken in a banding trap on Long Island, October 30.

Records from the Tinker Harbor, Labrador station (25 recoveries), show recoveries on Long Island (where there were none previously) in November and December which conform to New Jersey records. There is also a record from Connecticut for the middle December period.

The new data from the Grand Codroy station (14 recoveries) in Newfoundland show 2 late November records for Massachusetts, a middle November record for New Jersey, and an early December record for Delaware. There are also recoveries for the Maritime Provinces and Long Island which reinforce the previous distribution data.

Likewise for the Penobscot River station in Maine, the Lake Champlain stations in Vermont, and the Seney station in Michigan, the 1951 data are similar in distribution to previous records. This lack of variation is particularly significant with the Penobscot River station for which there are 45 new direct shooting recoveries. There are only 5 and 3 new records, respectively, for the Champlain and Seney stations.

An expanded banding program during 1951 by the Maine Cooperative Wildlife Research Unit included trapping on the Moosehorn National Wildlife Refuge and vicinity. Recoveries from this banding total 22 from shooting, of which 20 are from bandings done prior to the shooting season. The distribution is similar to that of the Penobscot River stations. Twenty percent of the recoveries were taken locally, 45 percent were taken from Long Island to North Carolina, and the remainder in New England and New Brunswick. There were two birds taken in banding traps on Long Island and in Maryland.

A concentrated early fall banding on the Parker River National Wildlife Refuge (Newburyport) and vicinity by the Massachusetts Division of Fisheries and Game produced a total of 218 shooting recoveries of which 205 are from bandings prior to the shooting season. The distribution is somewhat similar to past records from this area, in that 82 percent of the recoveries come from the local banding area. However, 11 percent of the recoveries (13 percent including hunting season bandings) are from the southern coastal area from Long Island to North Carolina. This is a 50 percent greater recovery in the south than was tallied from previous records. The increased percentage in the southern recovery, though not involving a large number of bands, was nevertheless unexpected, because a most intensive campaign was conducted in the field, and assistance was given by members of sporting clubs to insure the recovery of as many bands as possible in the local banding area.

In regard to recent literature the treatise entitled Survival Studies of Banded Birds, by Joseph J. Hickey (Spec. Sci. Rpt.: Wildlife, No. 15, United States Department of the Interior, June 1952) was not published at the time this report was written. Although the black duck is not discussed in detail in this publication, the report is recommended to the reader because many of the comments made by Dr. Hickey concerning biases, and inaccuracies of the banding records may be applied to black duck recoveries as well.

Distribution of the Banding Effort

Over the past 32 years, black ducks have been banded in 41 states and provinces (fig. 32). In many states the banding effort has been meager. In other states major programs have resulted in significant volumes of data. Unfortunately, much of the banding has been uncoordinated so that until recently it was seldom that more than a few important stations

were in operation at one time. Table 1 shows in detail this rather haphazard distribution of effort. In the left column is listed the states and provinces in which banding was done, and in the second column, the number of fall shooting records available from each of these states. The period in which banding was done is represented in the year columns by an X or a bar. The bar indicates the period in which most of the banding was carried out, and the X indicates an incidental amount. Since this chart gives most of the pertinent details the following discussion deals only with some of the more important contributions.

Mention will be made only of important publications in which actual studies of banding records serve as a basis. Most migration reports concern the analysis of local banding data but those by Bent (1923), Lincoln (1939, 1950), Cooke (1906), Aldrich (1949), and others, primarily in the United States Federal Service, deal with continent-wide movements and banding data from many sources are utilized.

One of the most important black duck banding operations was also the first. This station, located at Lake Scugog in southeastern Ontario, was operated primarily by H. S. Osler. Banding was started in 1918 but did not get into full swing until the period 1922-26. The results of the Scugog bandings were summarized in part by Lloyd (1930). Black ducks have been banded also at Toronto and at Moosonee, Ontario. The latter station has been operated by the Ontario Department of Lands and Forests for only a year, and because of its strategic location, it is hoped that it will continue in operation at least for several more.

Shortly after the Scugog endeavor became well established, a program was inaugurated (1921) by Pulitzer in Hancock, Maine, which ran for 3 years. Then, for a period of some 20 years only a few blacks were banded at several points in Maine both inland and on the coast. It was not until 1945 that the Maine Cooperative Wildlife Research Unit under Mendall started on an expanding program in the Penobscot Valley. It is these latter bandings that have produced most of the data available from Maine.

In the late twenties and early thirties extensive programs were initiated particularly in New York, Massachusetts, Connecticut, and Michigan.

The New York endeavor, starting in earnest in 1927, centered in Rochester on Lake Ontario, and in the Southampton-Quogue areas of Long Island. The Rochester station operated by W. B. Large and J. H. White continued until 1944 with only limited bandings during the middle thirties. The stations at the eastern end of Long Island, except for the war years, continued until the present time. These latter important bandings are largely the result of voluntary efforts of persons operating the Southampton Township Wildfowl Sanctuary, particularly Ross Frederico and C. J. Mercer.

Table 1 - Distribution of Banding 1/

State or Prov.	No. Recov- eries.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935
Labrador	56																		
Quebec	160													X	X	X	X		
Ontario	992	X	X								X	X				X	X		
N'fld.	84																		
N. S.	35					X					X	X	X	X			X		
P.E.I.	10																		
N. B.	89										X				X	X			
MAINE	298									X	X								
N. H.	12																		
VERMONT	221																		
MASS.	3207					X				X	X	X							
RHODE I.	26														X	X	X		
CONN.	421					X	X				X	X							
LONG IS.	1570								X								X		
N. Y.	2121						X	X	X									X	
PENN.	196																X	X	
N. J.	132																		
DEL.	39																		
MD.	152														X				
VA.	135															X	X		
N. C.	82																		
S. C.	141							X		X		X		X					
FLA.	5																		

1/ Shooting recoveries only received up through January 1951.

State

of

Prov.	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
Labrador															
Quebec	X														
Ontario		X	X		X						X				
Nfld.															
N. S.	X	X	X											X	X
P.E.I.														X	
N.B.				X	X	X									
Maine			X	X		X	X	X	X						
N. H.													X		X
Vermont															
Mass.															
Rhode Is.															
Conn.	X	X	X							X	X			X	
Long Is.															
N. Y.	X	X							X	X					
Penn.	X	X													
N. J.													X	X	X
Del.					X	X					X	X	X		
Md.		X	X				X			X	X		X	X	X
Va.	X		X	X	X	X	X	X				X	X	X	X
N. C.															X
S.C.							X	X	X		X	X			X
Fla.	X					X									

TOTAL RECOVERIES 10,184

State
or

Prov.

	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	1950
Michigan															
Ill.	X	X	X	X	X					X					X
Ohio	X						X					X			
Tenn.									X					X	
Wisc.	X	X	X		X	X	X	X		X	X	X	X	X	X
Ind.	X	X	X									X	X		
Iowa				X											
Manitoba				X				X							
Alberta												X			X
Montana				X										X	
Minn.							X								X
Ky.															X
S. Dakota		X	X	X	X		X							X	
Arkansas			X	X	X										
Missouri		X	X												X
Louisiana	X	X	X		X										
Oklahoma				X	X	X		X	X				X		
Sask.										X					X
Ala.							X			X			X	X	X

TOTAL RECOVERIES 5,297

In 1932 and 1933 a vigorous banding program was carried out at Wantagh, Long Island, by William Vogt. In the nearby New York Zoological Park area (Bronx) banding was conducted intermittently and on a limited basis up to the present time. Beginning in the early thirties and continuing intermittently to the early forties limited bandings by A. A. Allen and others were under way also in the Ithaca-Montezuma region of Central New York, but it was not until 1945 that the New York Conservation Department, employing technicians, launched a state-wide banding program at Lake Alice, Tomhannock Reservoir, Perch Lake, Montezuma, Oneida Lake, Oak Orchard, and at the Long Island stations. This valuable program has continued to the present time. Mason (1947) ably summarized all the New York data in a final Pittman-Robertson Report for Project 21-R and Wells (1951) applied the over-all banding data to a management plan for New York.

Although a few miscellaneous bandings were undertaken in Massachusetts during the twenties the important stations started operation in 1930. Practically all of the banding from 1930 to 1941 was on Cape Cod at North Eastham and at Brewster. These important studies were carried out by the O. L. Austin Ornithological Station at North Eastham, and by J. J. Storrow and A. Rotch at Brewster. From the winter of 1939-40 to the fall of 1944 the Massachusetts Department of Conservation carried on a banding program at Newburyport and from 1945 to the present the work was continued on Parker River Refuge by Fish and Wildlife Service employees. In addition to the coastal bandings the Conservation Department operated during 1943 to 1946 several small inland stations across the state as far west as the Connecticut River.

As a partial fulfilment of Pittman-Robertson Project 4-R, Addy (1945), who took part in the Newburyport and inland bandings, summarized all of the Massachusetts records. Later, Hagar (1946) who started the Newburyport program and cooperated in some of the Cape Cod work, brought out an analysis of the Austin records. The results of Hagar's Cape Cod analysis were applied also in other writings (1945, 1950, 1951).

Even before the Massachusetts program, extensive trappings were started in Michigan (in 1927) at Munuscong on the Upper Peninsula. Since then black duck banding has been carried on without interruption in Michigan at several points, though not continuously at any one station. The bulk of the Munuscong records come from the period 1927-1935 but limited banding continued into the early forties. At about the same time, limited studies were being conducted at Seney but the most important period for this station was 1941-48. The Munuscong and Seney operations were carried out largely by employees of the Department of Conservation and the Fish and Wildlife Service, respectively.

In the Southern Peninsula a number of stations have been in operation at various times since 1928. The bulk of these bandings were carried out in the south-central portion of the state in the Battle Creek-Kalamazoo-Lansing area beginning in 1931 with the period 1931 to

1935 being the most important. Dr. Miles D. Pirnie of the Kellogg Sanctuary had charge of most of these operations. A limited program was carried out also at Muskegon, 1930-34, and in the Milford-Detroit River area intermittently from 1928 to the present by the Michigan Conservation Department.

The results of the Munuscong and Kellogg bandings were summarized by Pirnie in 1931 and 1935.

Connecticut bandings have been erratic over the years, from their beginnings in 1922. Most of the records come from two periods (1933-35 and 1949-50) with Litchfield and the Saybrook-East Lyme areas the principal banding localities. The earlier bandings were conducted by P. H. Barney, and during the last few years by James Bishop and others of the Connecticut Board of Fisheries and Game. These records have not been completely summarized although Sondrini and Bishop (1951) have presented problems relative to their 1948-1950 studies.

Several northern states have been mentioned in which banding started in the thirties and continued through the forties to the present time. In addition to these, Illinois, Indiana, Wisconsin, Ohio, Pennsylvania, and the eastern Canadian Provinces are worth mentioning.

There was little done on black duck banding in Illinois until the early forties although some records as far back as 1922 are on file. The principal trapping periods have been 1941-44 and 1946-49. Most of the banding has been carried out in the Orland Park-Barrington area near Chicago, at the Chautauqua Refuge, Havana, and the Spring Lake Refuge near Savannah. The Orland Park work was done by J. Jedlicka and others connected with the Cook County Forest Preserve District and the Chautauqua and Spring Lake programs by employees of the State Natural History Survey. The Orland Park data from 1940 to 1945 have been summarized by Mann (1943, 1944) and Mann, Thompson, and Jedlicka (1947). The records for Spring Lake and Chautauqua have not been summarized from the standpoint of migration but the data has been used in mortality studies by Bellrose (1944).

Bandings in Posey and Rensselaer counties, Indiana, have been limited and conducted intermittently since 1936. A limited amount of banding has been done in Wisconsin almost every year for the past 27. One year (1930), at Big Suamico, accounts for about a third of all the recoveries. Many stations are involved in the Wisconsin bandings but the few important ones are the Campbellsport-Big Suamico area, Horicon Refuge, and Necedah Refuge.

The number of recoveries available for Ohio is about equal to that of Wisconsin but the spread of records is more reduced. The principal period of banding has been 1939-41 and 1946. Black Ducks have been banded at several scattered points but the main locations

have been at Ashland, Akron, and Celina with the first accounting for most of the records. Carl R. Warren conducted most of these studies and summarized the data in 1945.

Warren (1950) likewise summarized the results of black duck bandings in Pennsylvania, carried out at Reading and Pymatuning by the Pennsylvania Game Commission. These bandings were largely concentrated in the periods of 1938-1940 and 1947-1950, and although limited in scope, are of considerable value.

Since 1947 new stations have been started in the Maritime Provinces, Quebec, Newfoundland, and Labrador by the Northeastern Wildlife Station and the Canadian Wildlife Service. Although the data from these stations are still rather limited in volume they have made perhaps the most significant contributions to the story of black duck migration in the East. Actually, banding of black ducks has been done on a limited scale in the Maritime Provinces by various wildlife officers, wardens, and others since the 1920's. John Tingley, at the time a New Brunswick warden, caught several hundred young birds by hand over a period of years and banded them. Likewise, during the past few years the breeding-ground survey crew with the aid of a Labrador retriever have caught and banded several hundred flightless juveniles.

The principal operation in Quebec has been at Baie Johan Beetz located on the north shore of the St. Lawrence River just north of Anticosti Island. However, in the period 1931-36 a limited number of black ducks were banded on the island off L'Islet, about 60 miles east of Quebec City. Also in 1950, new bandings were started by the Quebec Department of Game and Fisheries, at Sorel, located on the St. Lawrence River at Lake St. Peter.

The Labrador station is located at Tinker Harbor on Hamilton River Inlet. It is understood that this valuable station is to be abandoned by the Canadian Wildlife Service due to the excessive expense involved in operation. The Newfoundland Station is located on the Grand Codroy River at the southwest tip of the Island. Most of the banding in New Brunswick has been in the vicinity of Sackville on the Tantramar marshes and in recent years the Canadian Wildlife Service has operated several bait traps there during August and September.

Wright (1948) who was responsible for setting up the first stations in Newfoundland, Labrador and eastern Quebec, reported on the results of the first year of banding. At this moment, he has also in manuscript form a summary dealing with a full five years of records from these new stations.

Unfortunately, the scope of banding in the southern states as well as in certain other northern ones has been too limited to give enough data for analysis. With many of these states a relatively large volume of records is necessary because the majority of the recoveries are taken from around the trapping area and the remaining records are frequently scattered widely over the United States and Canada.

The principal bandings in the south are located in the Atlantic Seaboard states at Carney's Point, New Jersey; Cambridge, Maryland; Chincoteague and Back Bay, Virginia; New Holland, North Carolina; and at Brookgreen, South Carolina. Although black ducks were banded in a few southern states during the twenties, the majority of the bandings took place in the thirties.

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BHL



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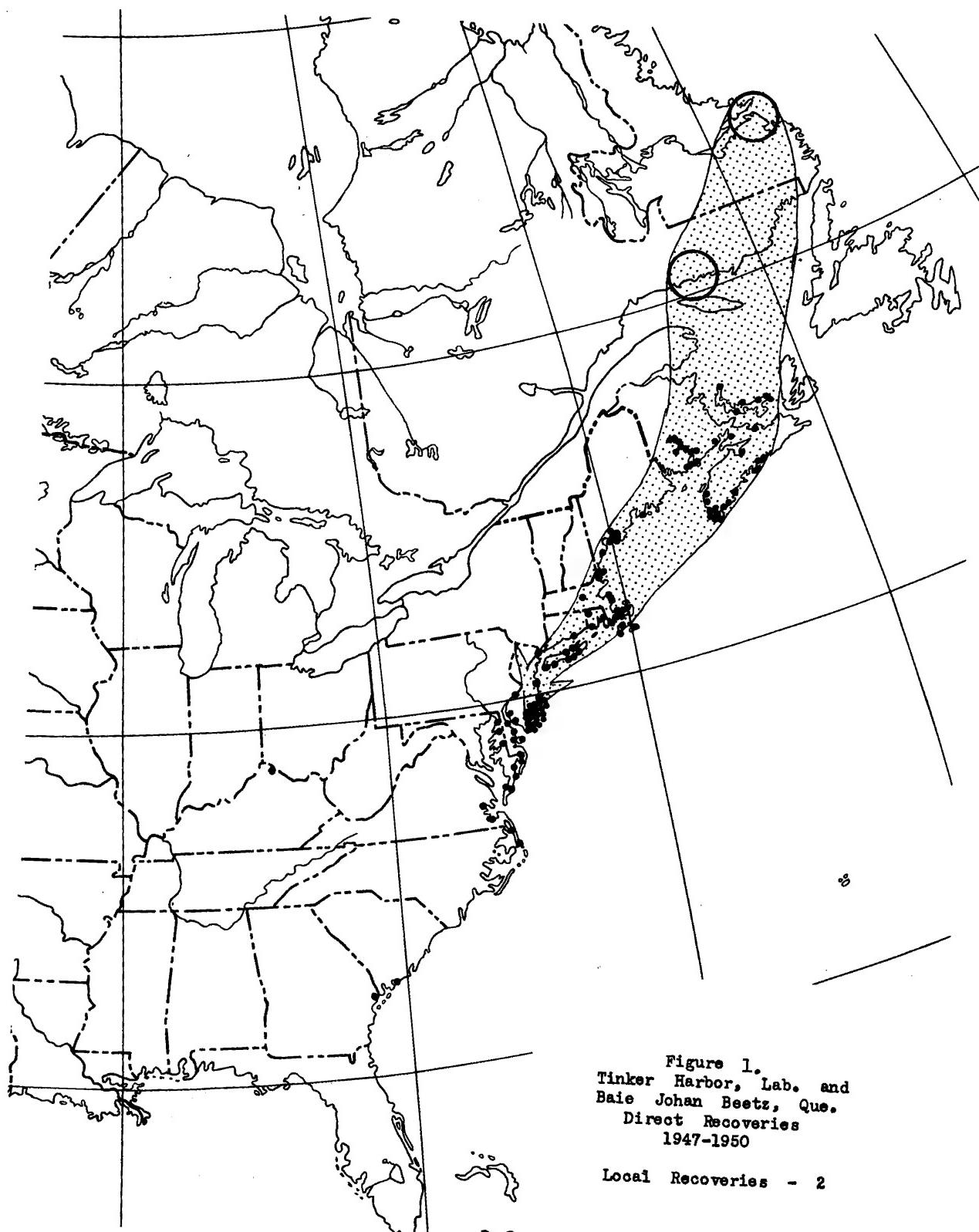


Figure 1.
Tinker Harbor, Lab. and
Baie Johan Beetz, Que.
Direct Recoveries
1947-1950

Local Recoveries - 2

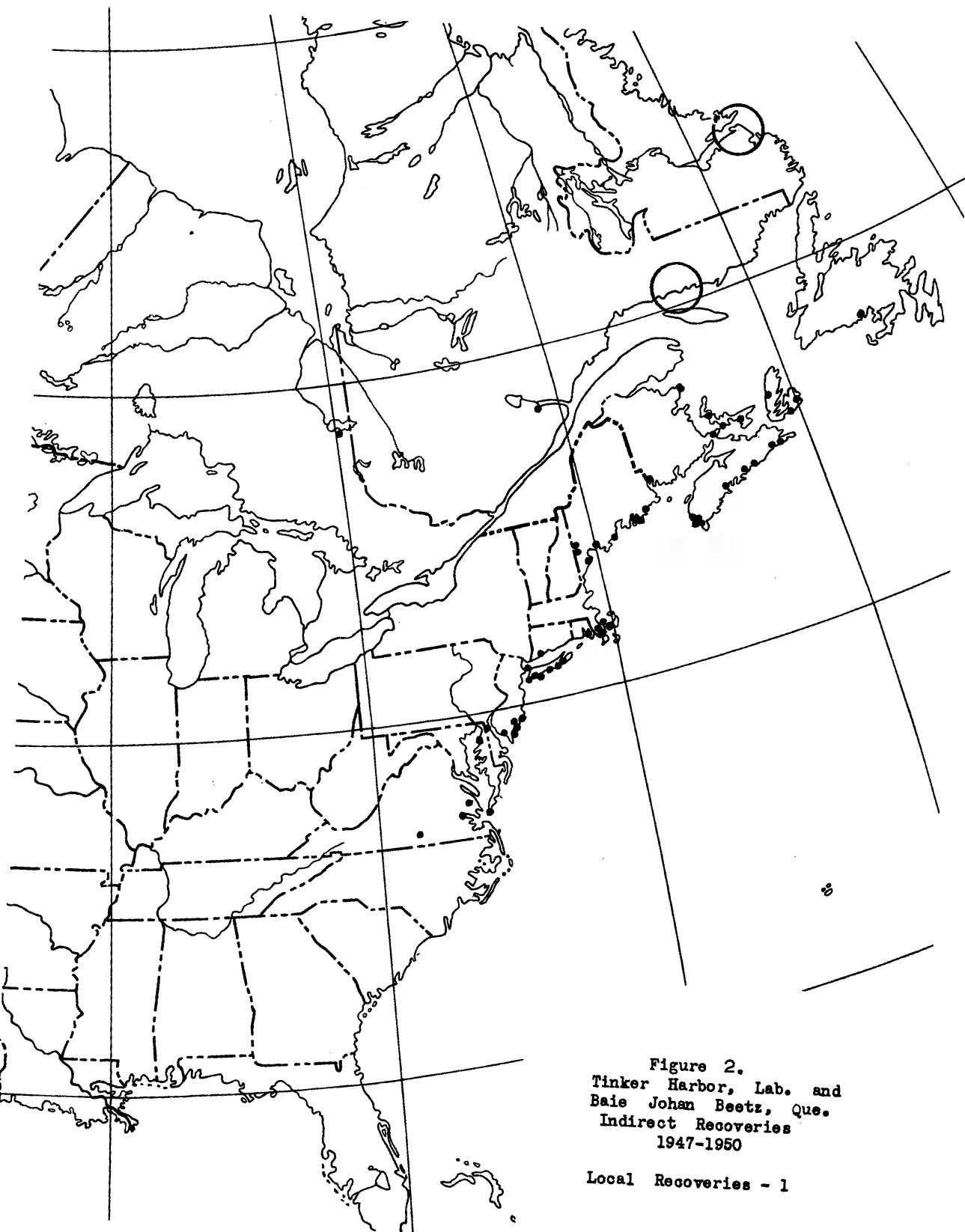


Figure 2.
Tinker Harbor, Lab. and
Baie Johan Beetz, Que.
Indirect Recoveries
1947-1950

Local Recoveries - 1

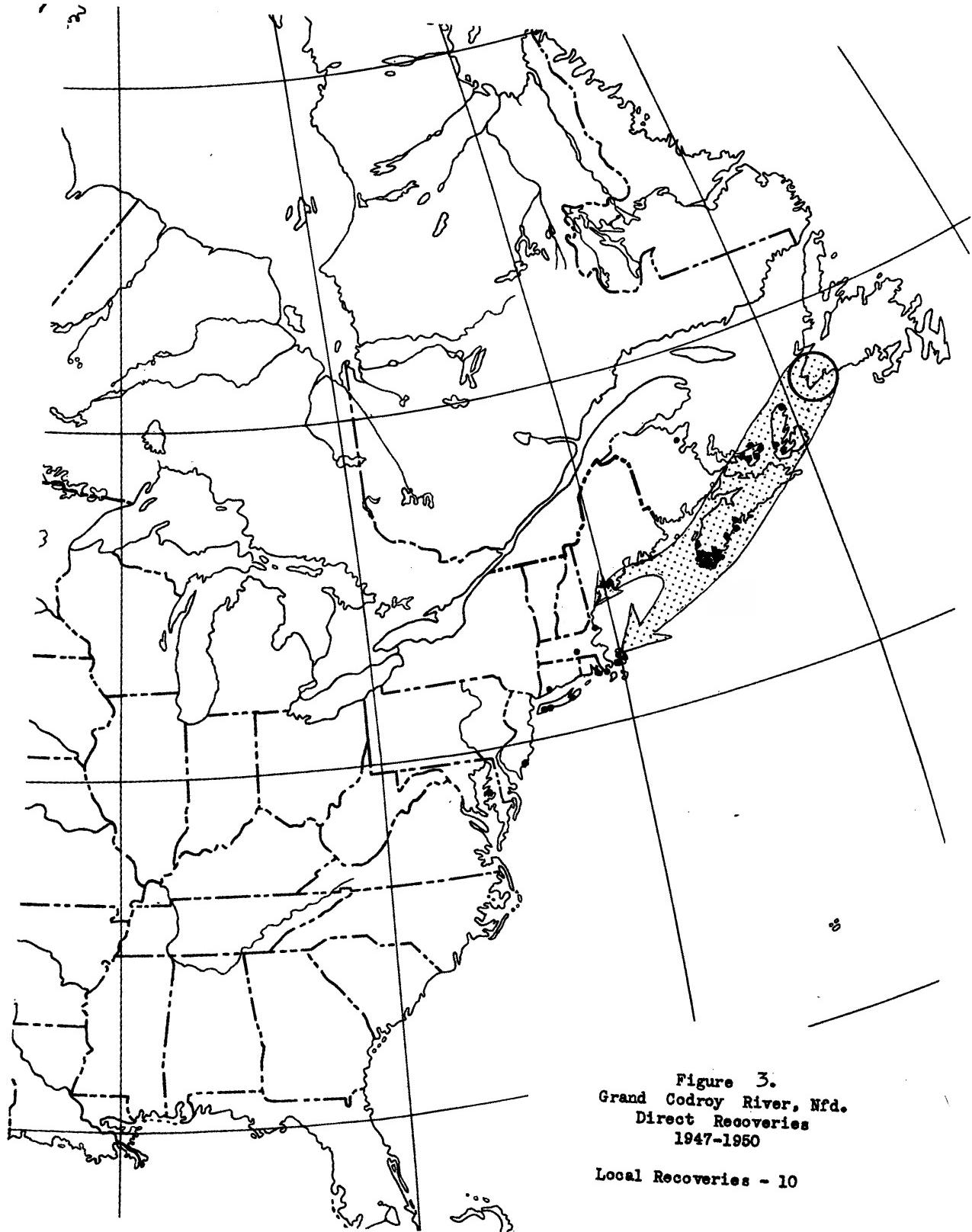


Figure 3.
Grand Codroy River, Nfd.
Direct Recoveries
1947-1950

Local Recoveries - 10

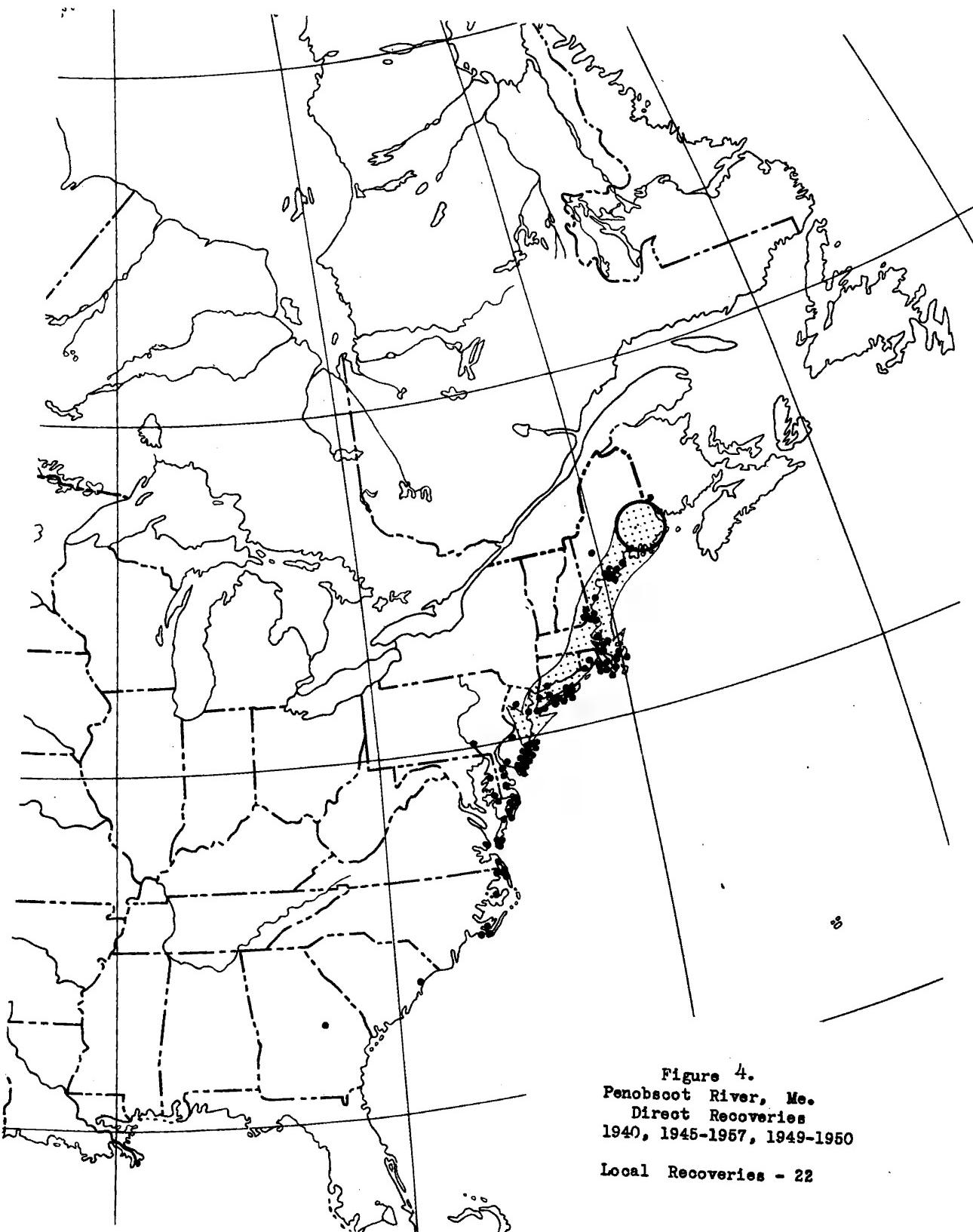


Figure 4.
Penobscot River, Me.
Direct Recoveries
1940, 1945-1957, 1949-1950

Local Recoveries - 22

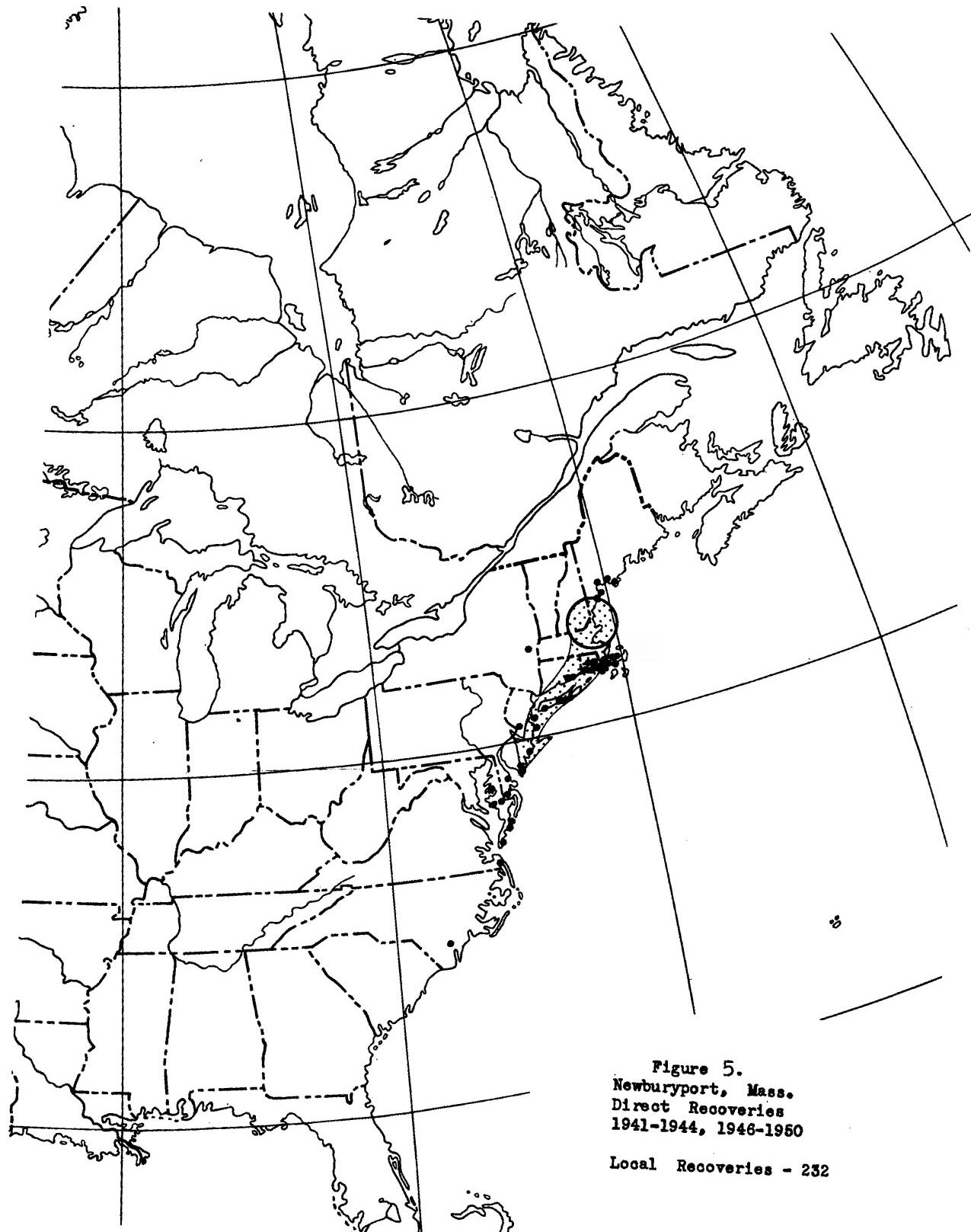


Figure 5.
Newburyport, Mass.
Direct Recoveries
1941-1944, 1946-1950

Local Recoveries - 232

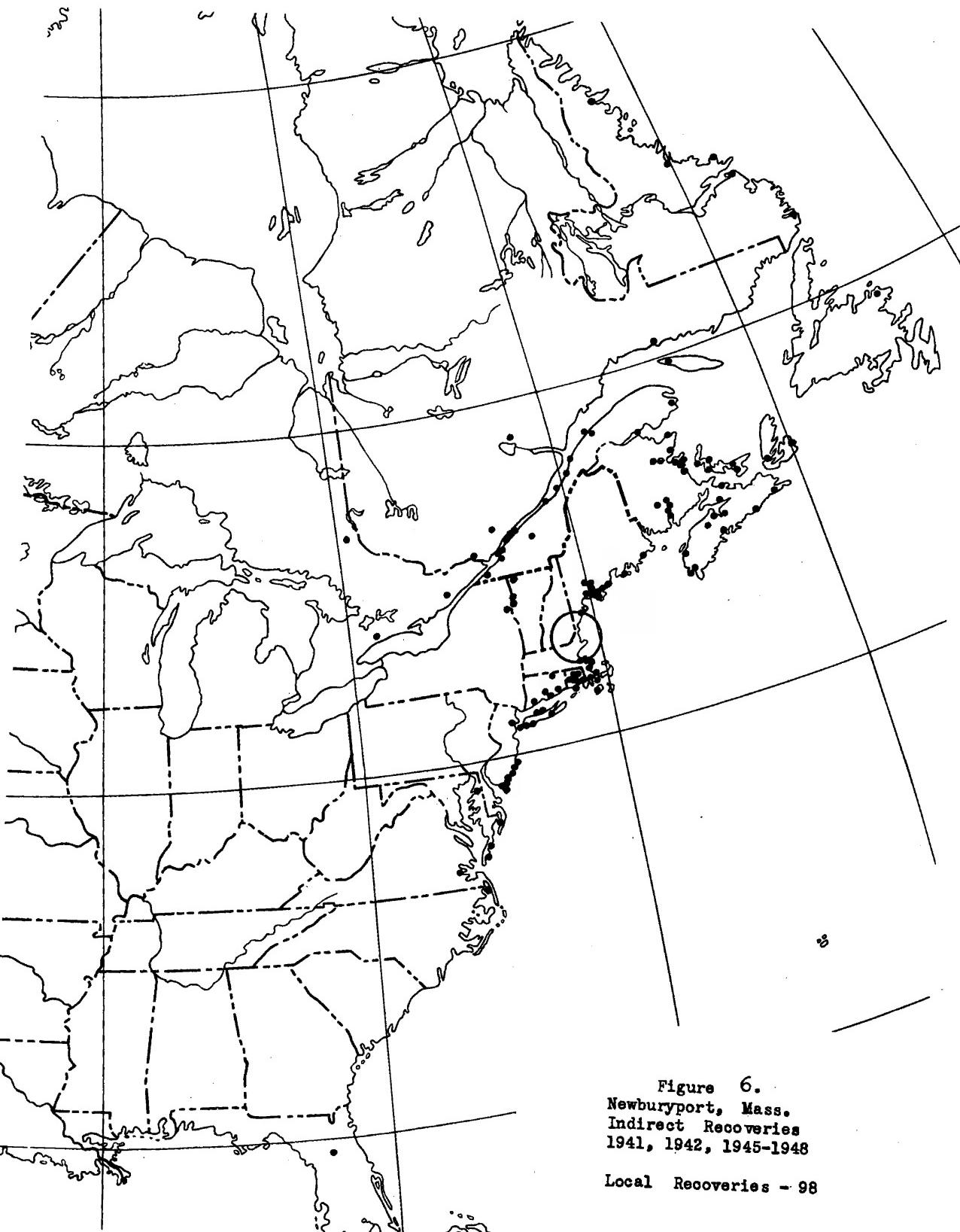
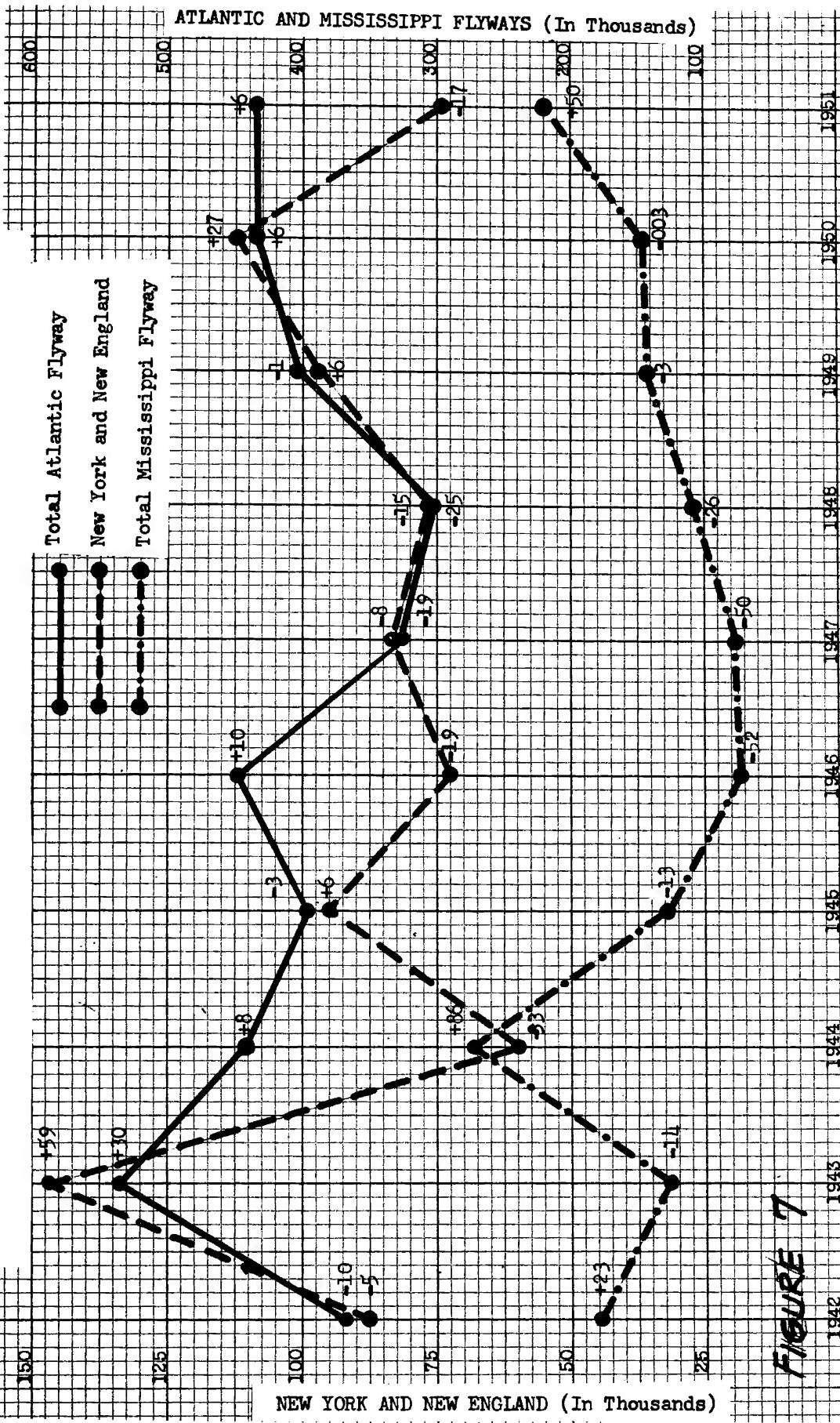


Figure 6.
Newburyport, Mass.
Indirect Recoveries
1941, 1942, 1945-1948

Local Recoveries - 98

WINTER BLACK DUCK POPULATIONS AND PERCENT CHANGES FROM THE AVERAGE
JANUARY INVENTORIES - 1942 ~ 1952

FIGURE 7



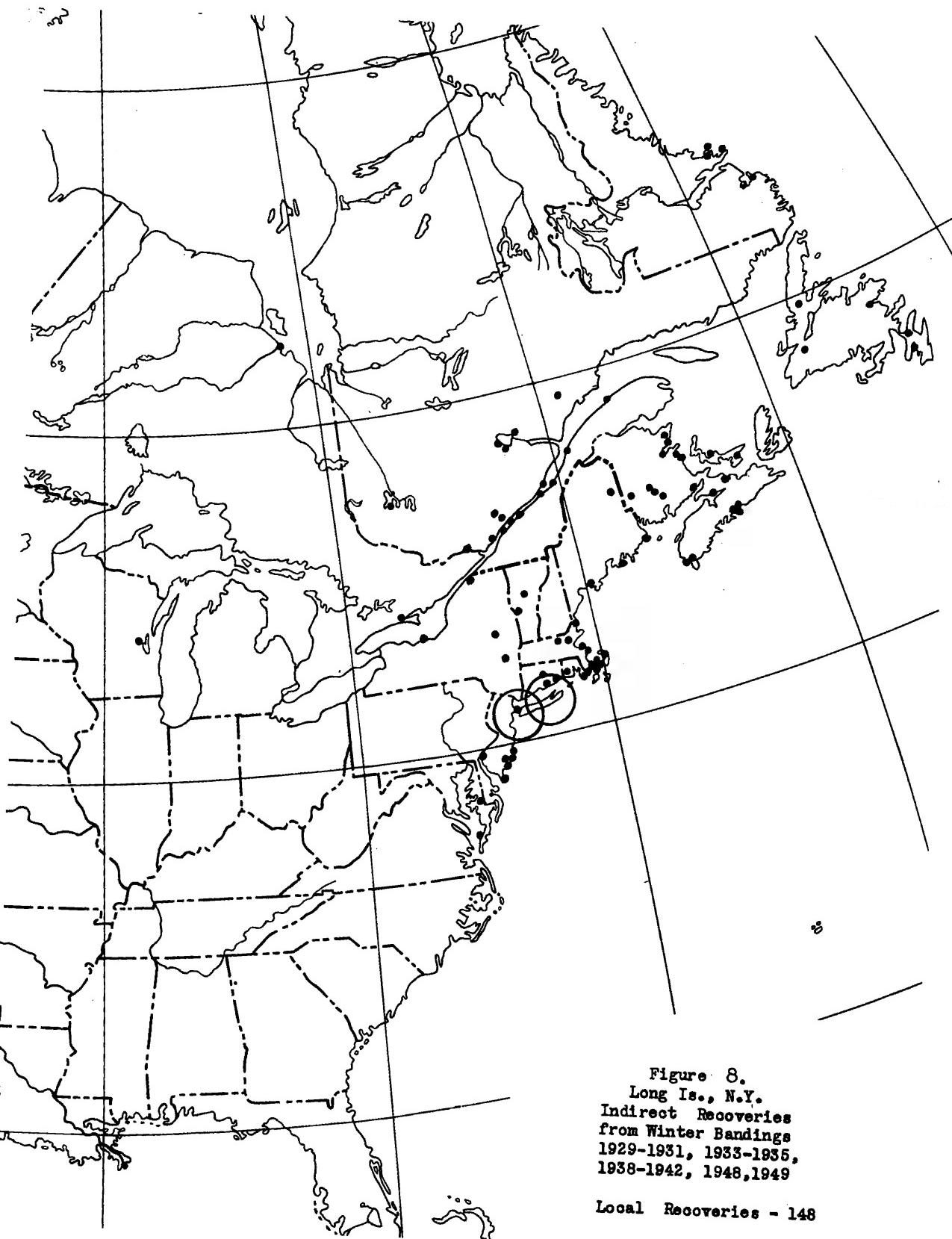


Figure 8.
Long Is., N.Y.
Indirect Recoveries
from Winter Bandings
1929-1931, 1933-1935,
1938-1942, 1948, 1949

Local Recoveries - 148

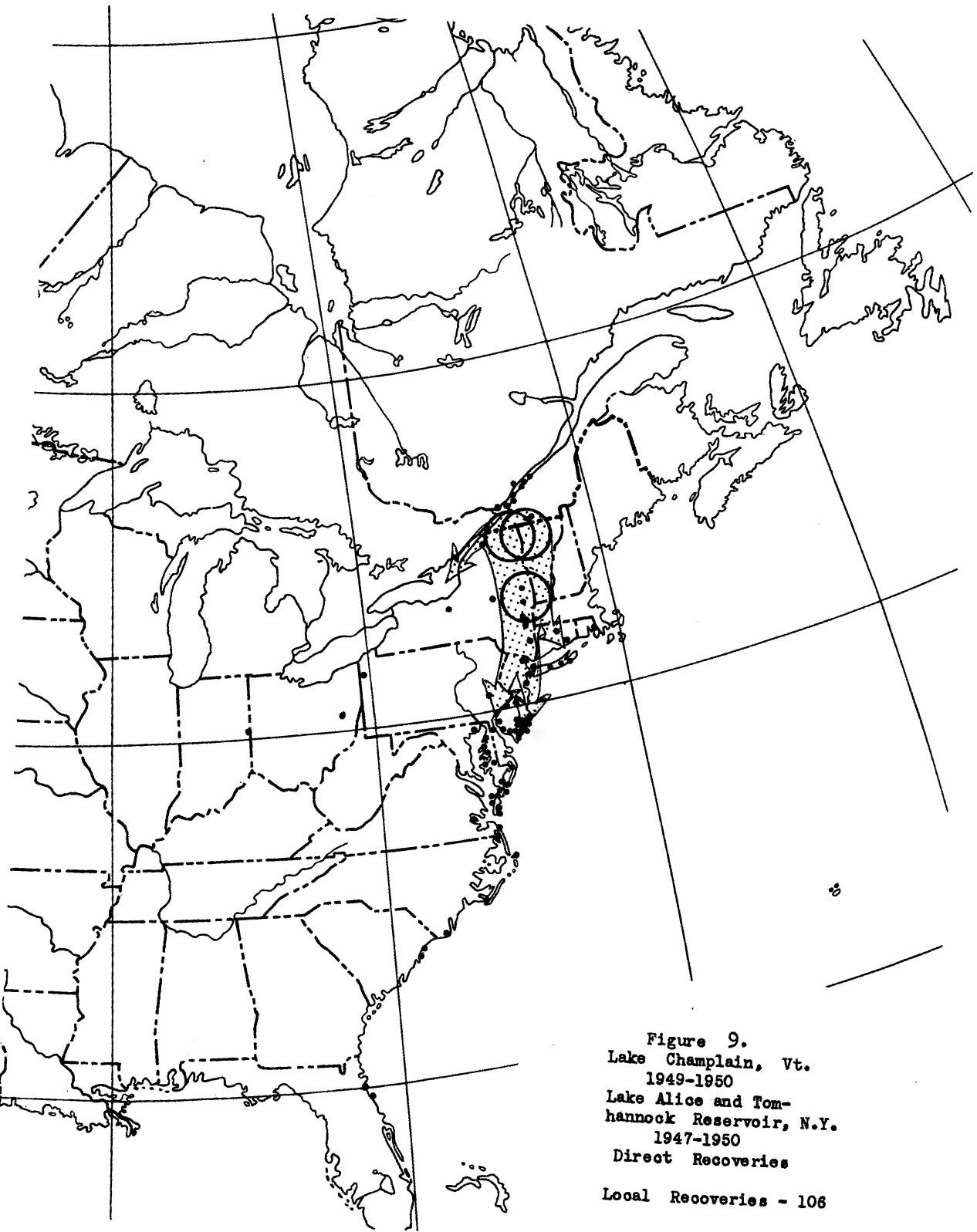


Figure 9.
Lake Champlain, Vt.
1949-1950
Lake Alice and Tom-
hannock Reservoir, N.Y.
1947-1950
Direct Recoveries

Local Recoveries - 106

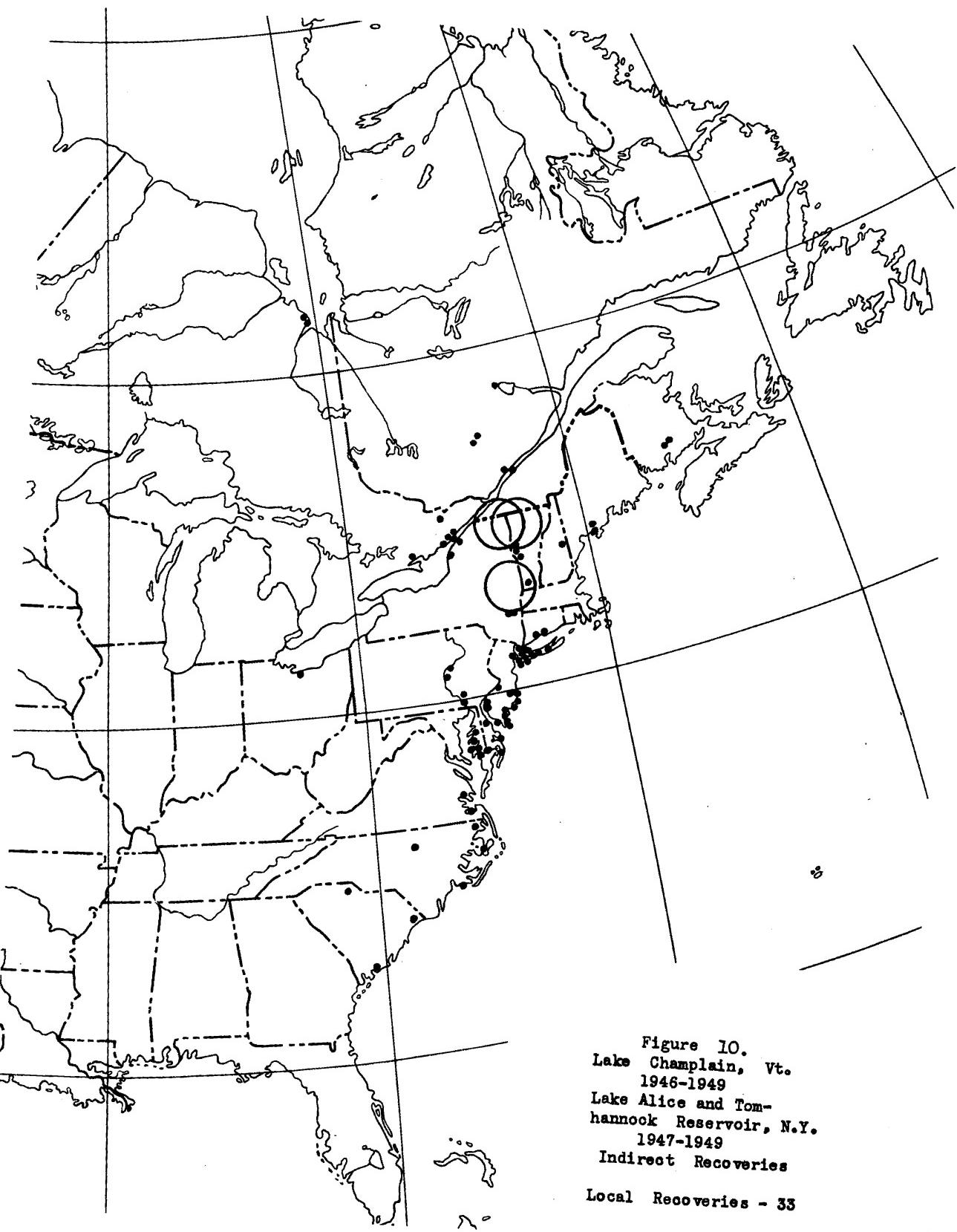


Figure 10.
Lake Champlain, Vt.
1946-1949
Lake Alice and Tom-
hannock Reservoir, N.Y.
1947-1949
Indirect Recoveries

Local Recoveries - 33

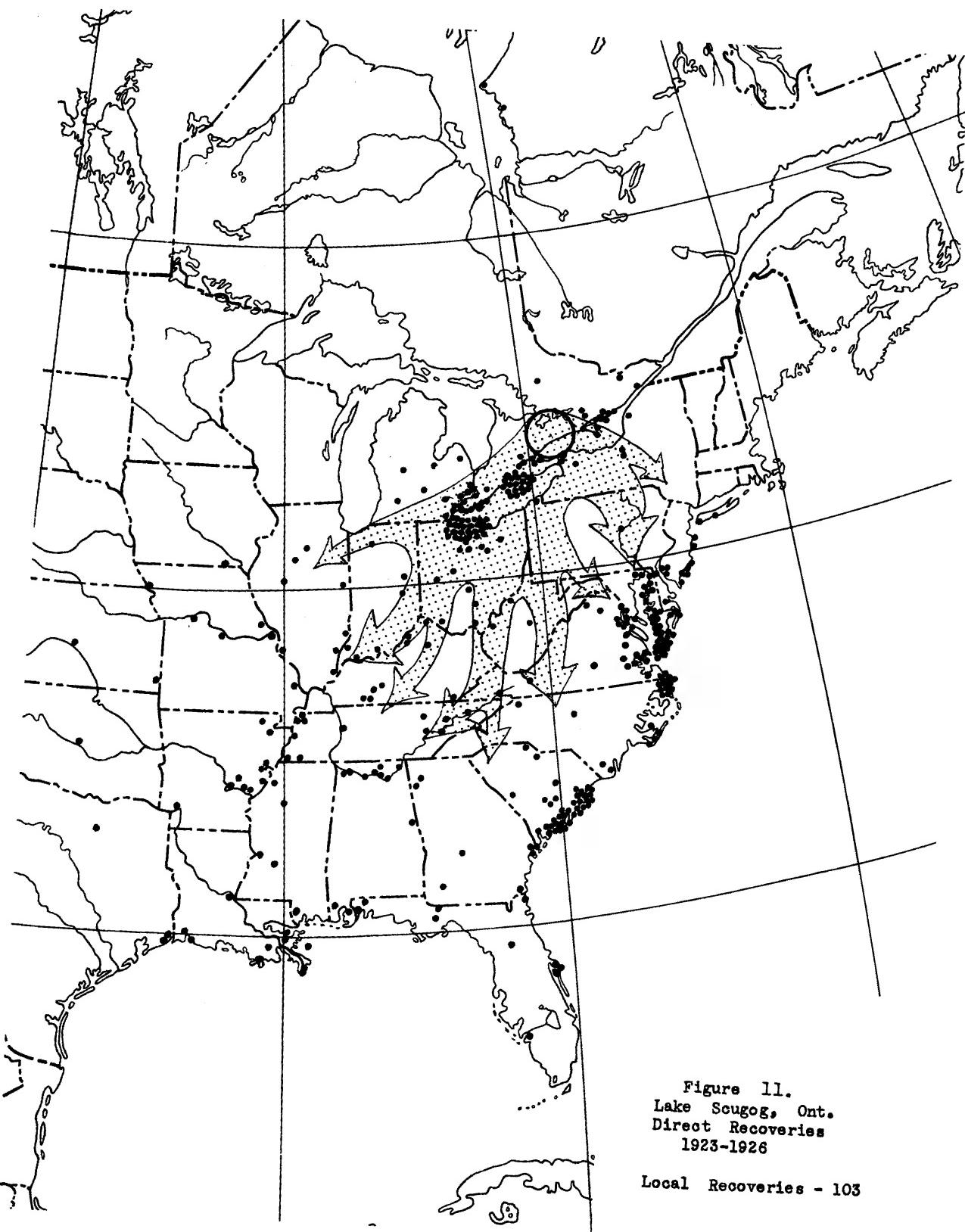


Figure 11.
Lake Scugog, Ont.
Direct Recoveries
1923-1926

Local Recoveries - 103

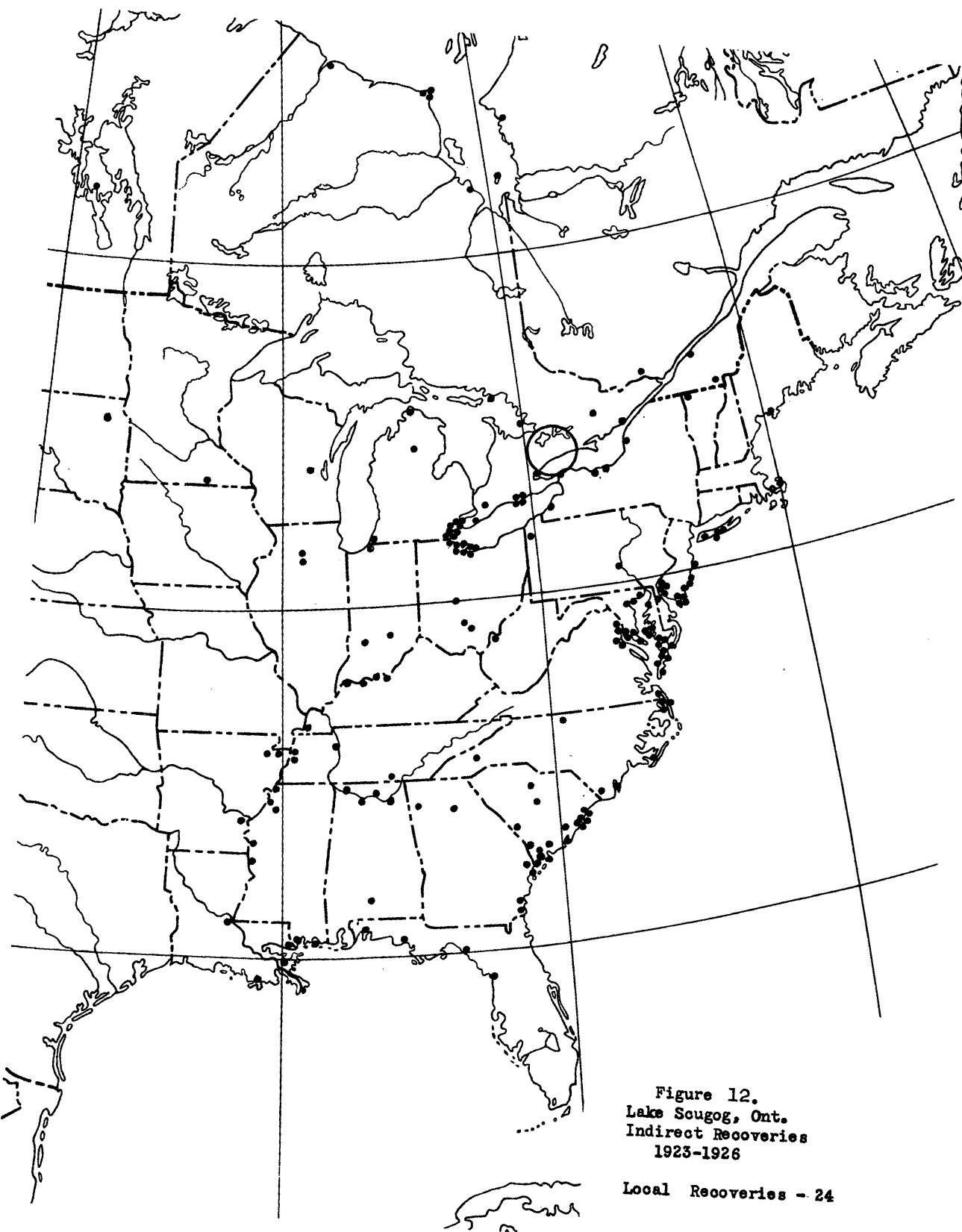


Figure 12.
Lake Scugog, Ont.
Indirect Recoveries
1923-1926

Local Recoveries - 24

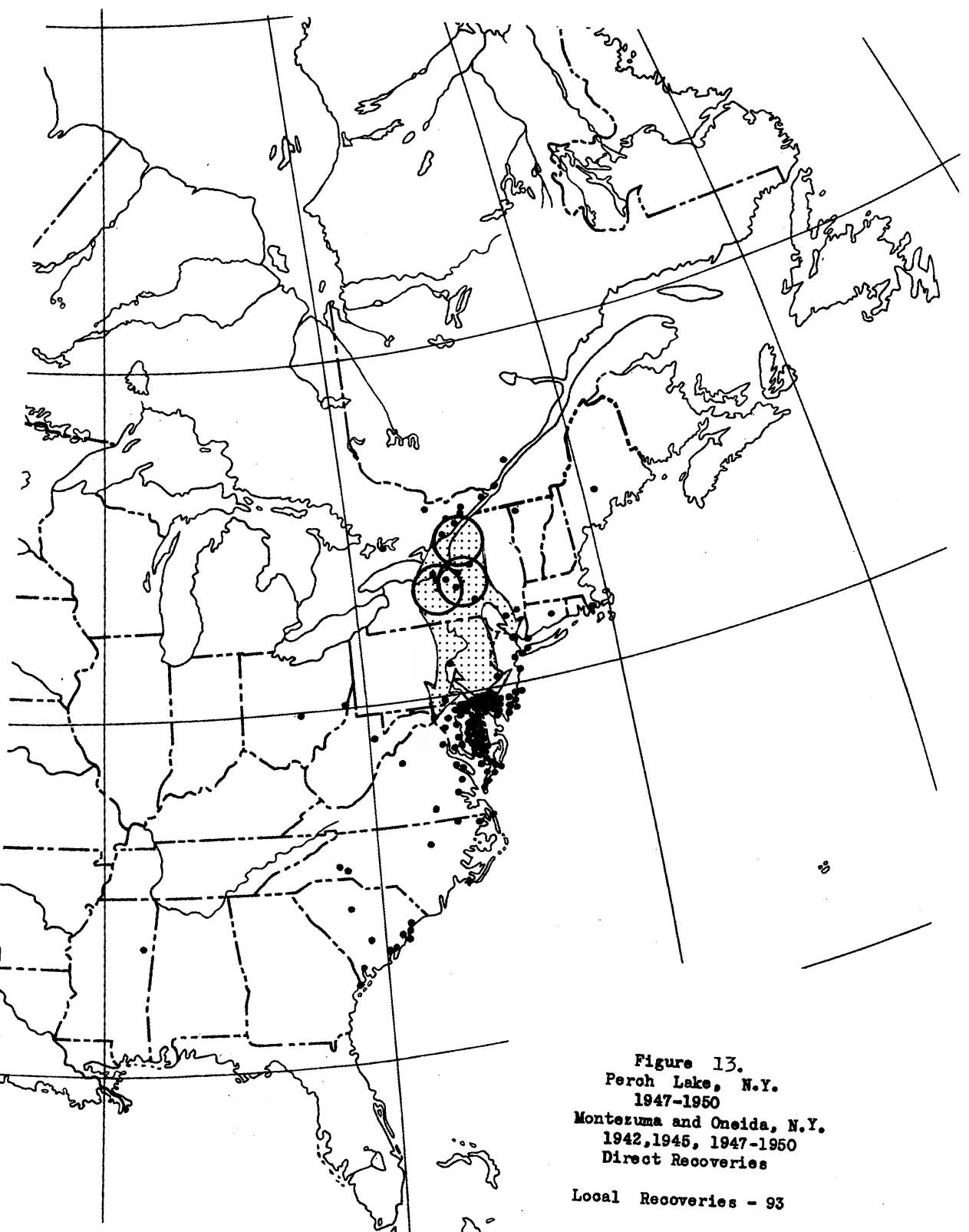


Figure 13.
Perch Lake, N.Y.
1947-1950
Monterzuma and Oneida, N.Y.
1942, 1945, 1947-1950
Direct Recoveries

Local Recoveries - 93

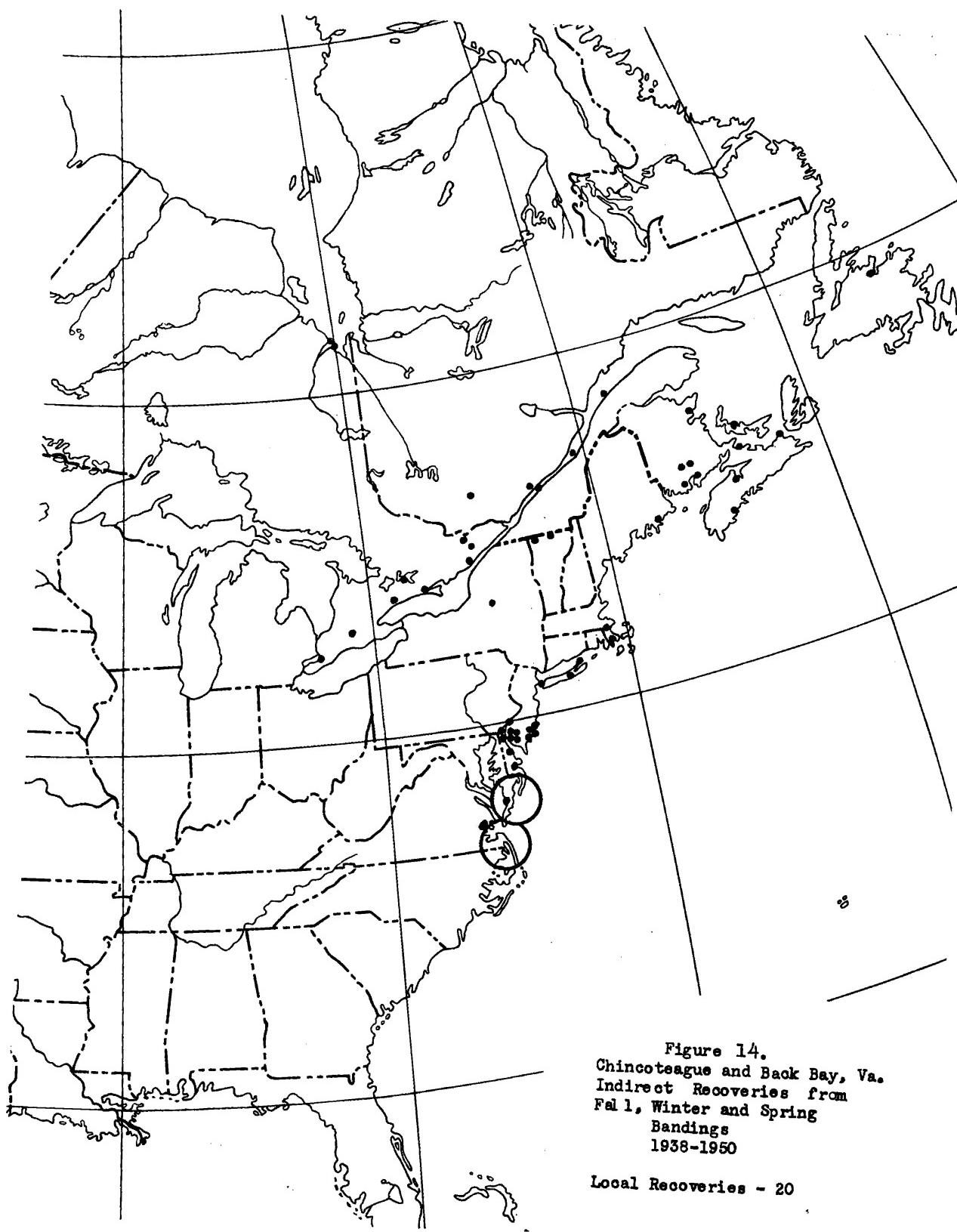


Figure 14.
Chincoteague and Back Bay, Va.
Indirect Recoveries from
Fall, Winter and Spring
Bandings
1938-1950

Local Recoveries - 20

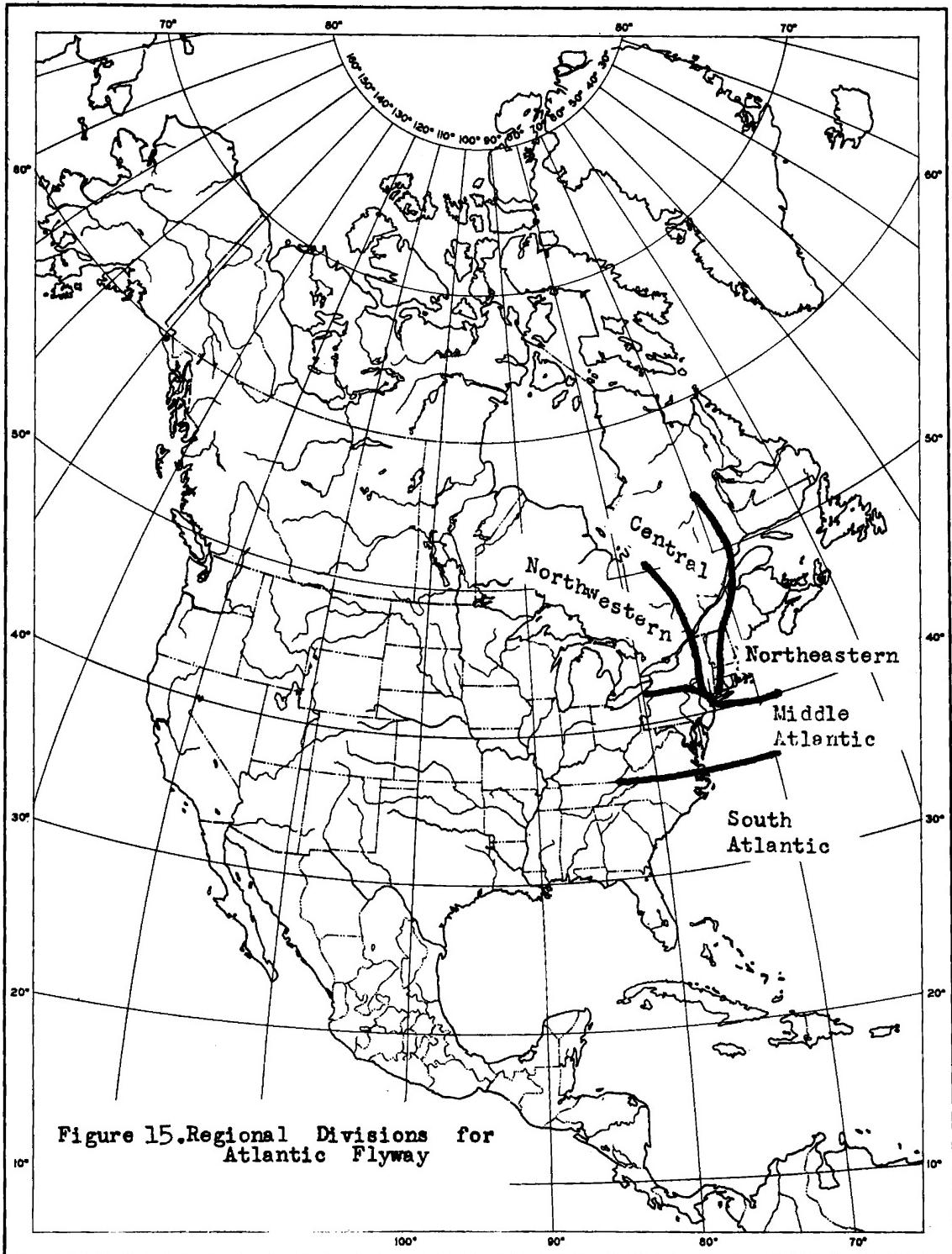


Figure 15. Regional Divisions for
Atlantic Flyway

Scale in Miles
0 50 100 200 400 600 800 1000 1200

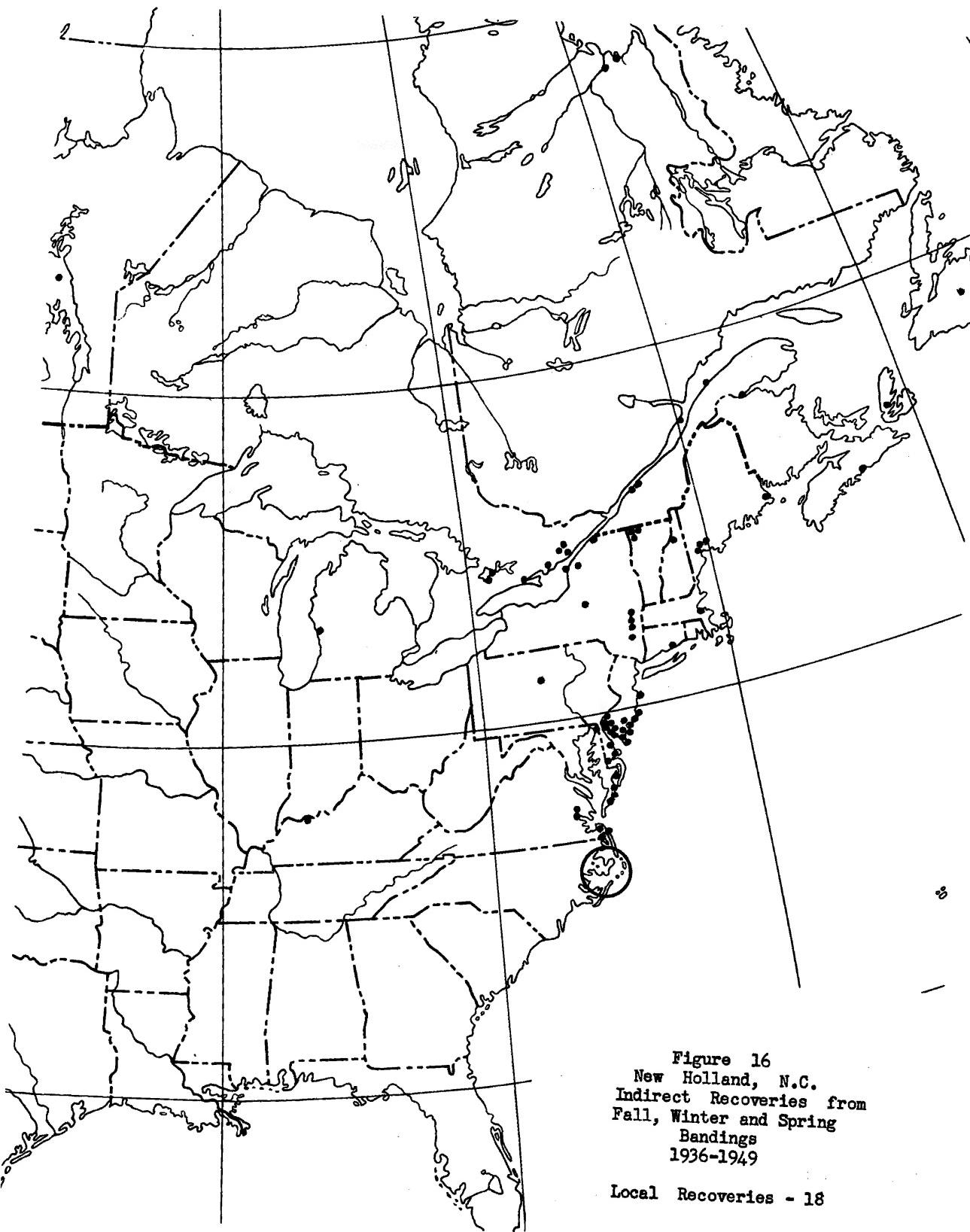


Figure 16
New Holland, N.C.
Indirect Recoveries from
Fall, Winter and Spring
Bandings
1936-1949

Local Recoveries - 18

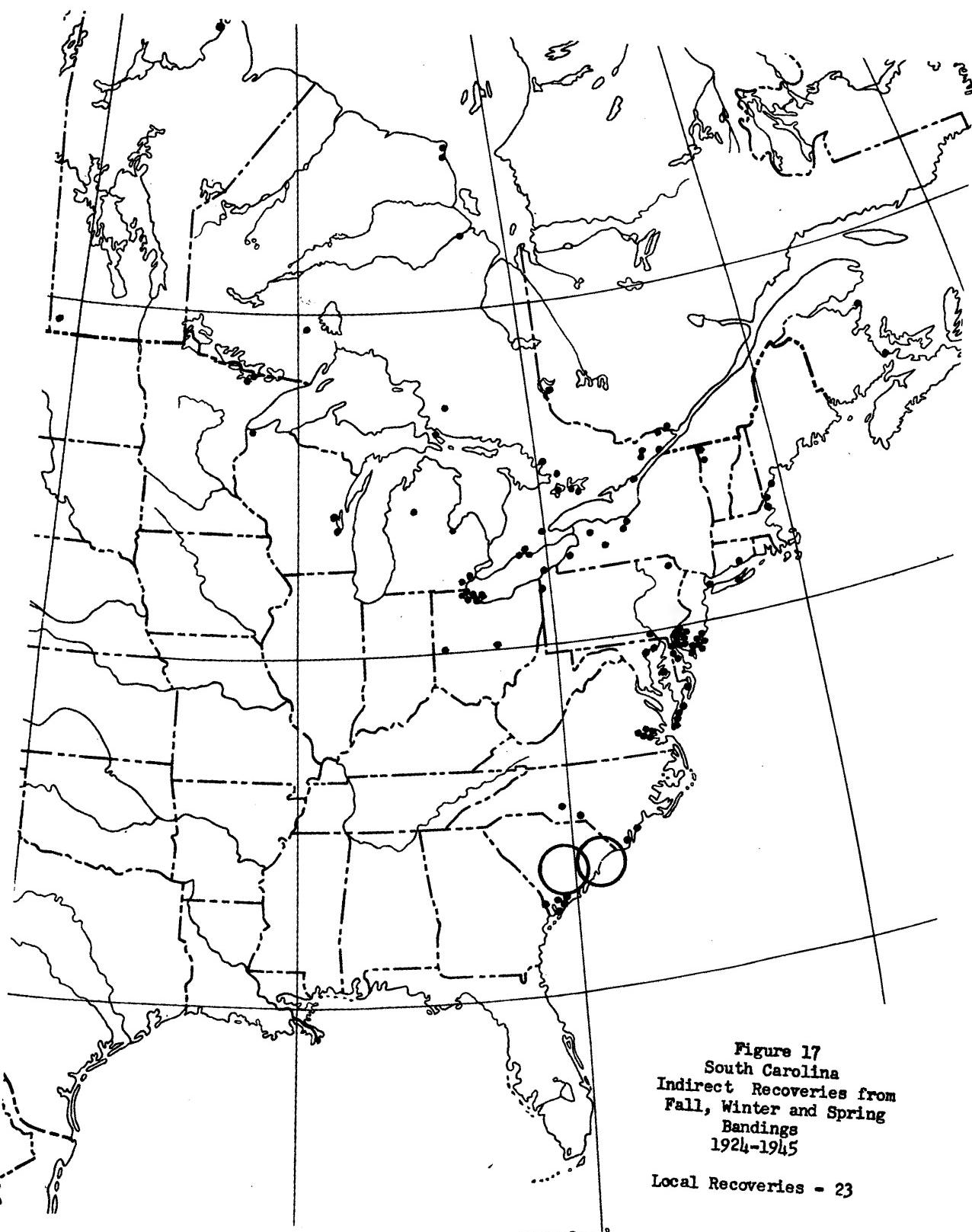


Figure 17
South Carolina
Indirect Recoveries from
Fall, Winter and Spring
Bandings
1924-1945

Local Recoveries - 23

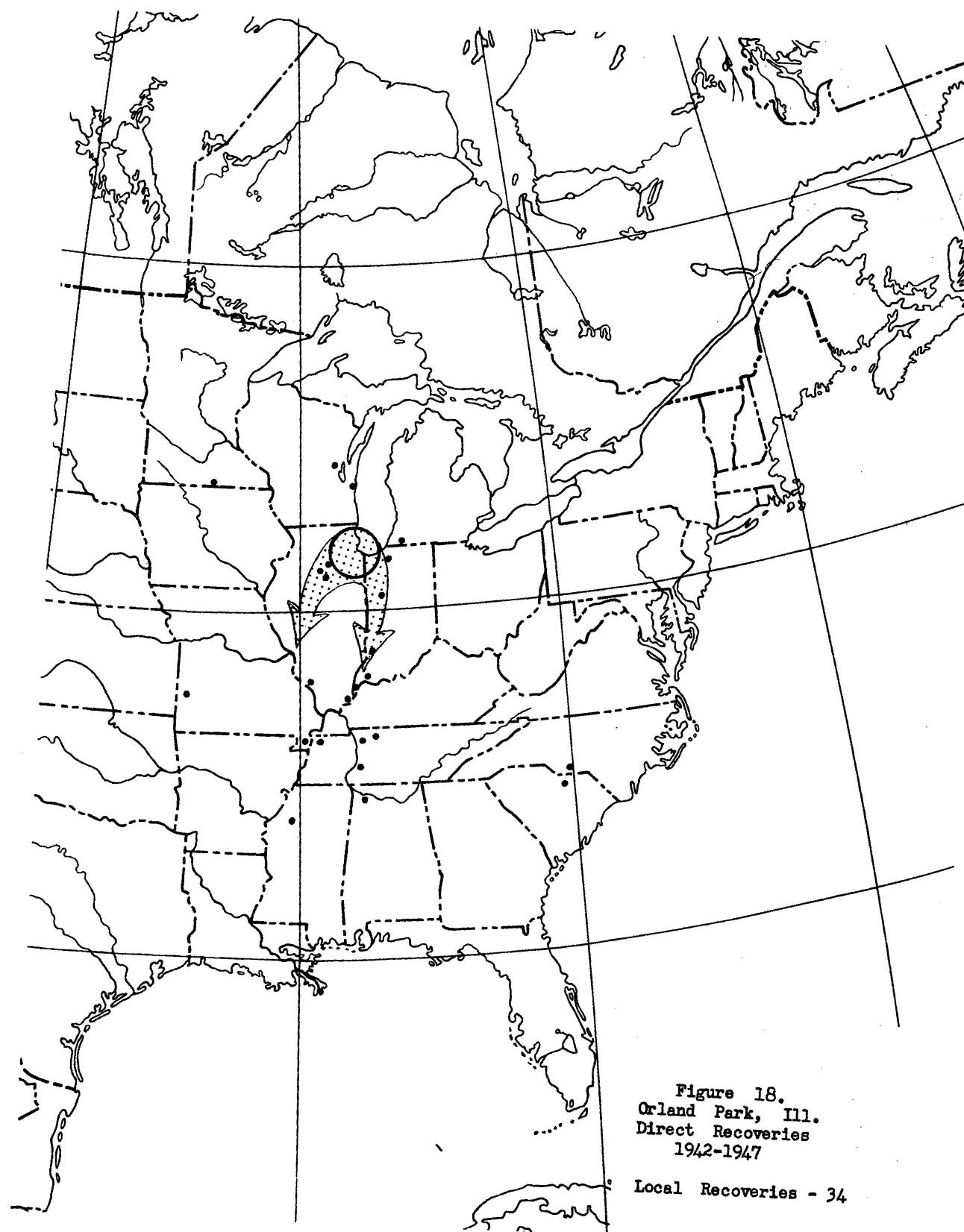


Figure 18.
Orland Park, Ill.
Direct Recoveries
1942-1947

Local Recoveries - 34

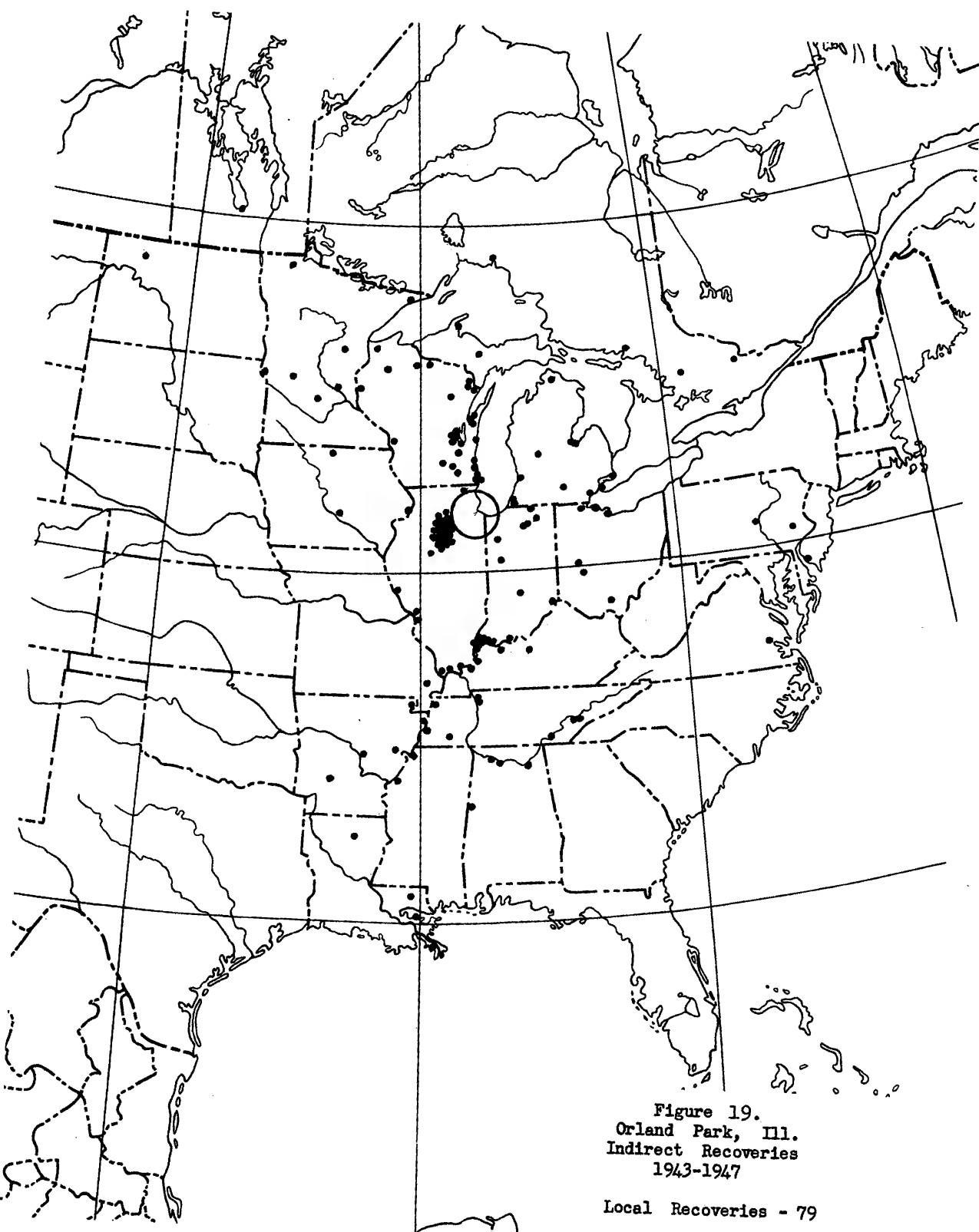


Figure 19.
Orland Park, Ill.
Indirect Recoveries
1943-1947

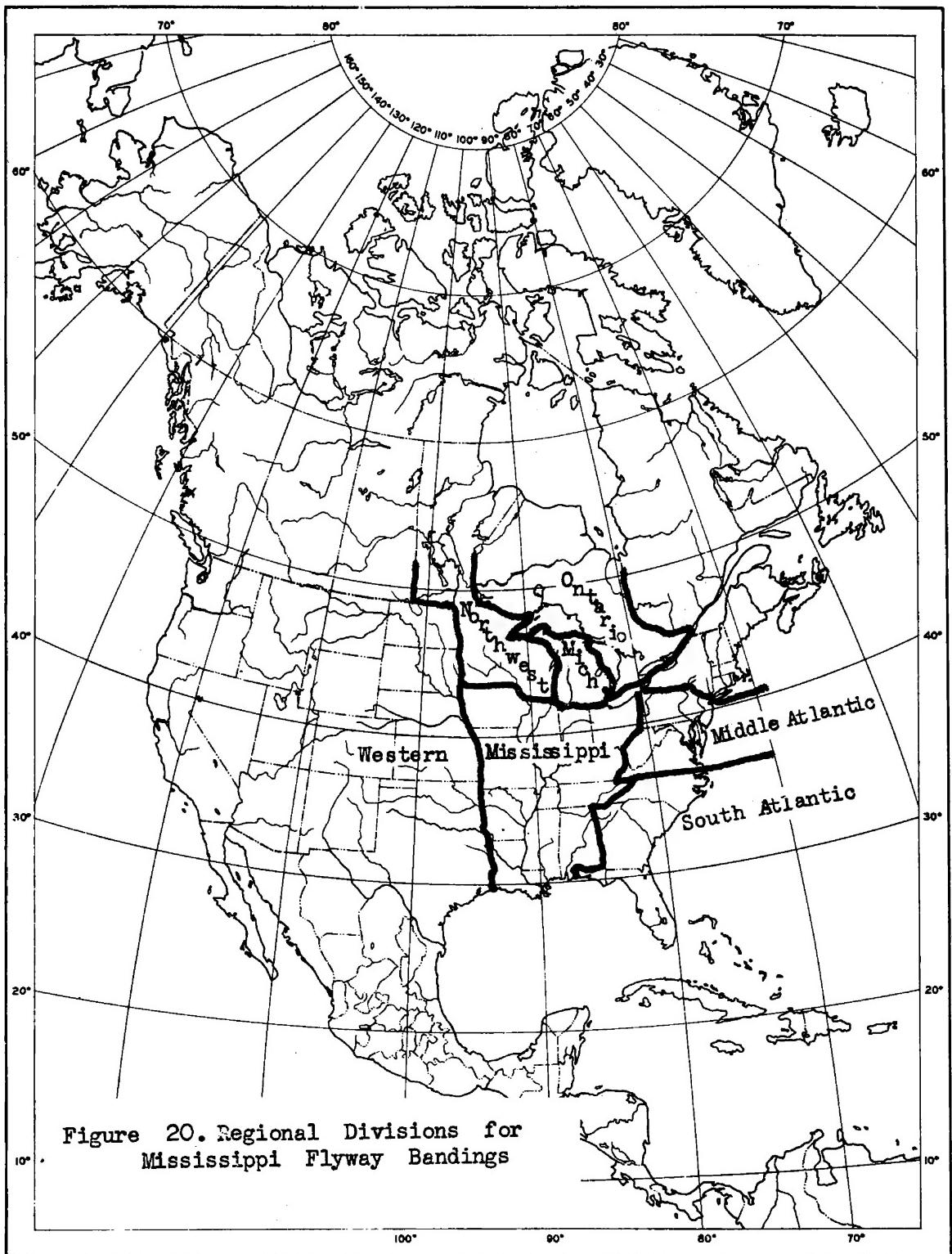


Figure 20. Regional Divisions for
Mississippi Flyway Bandings

Scale in Miles
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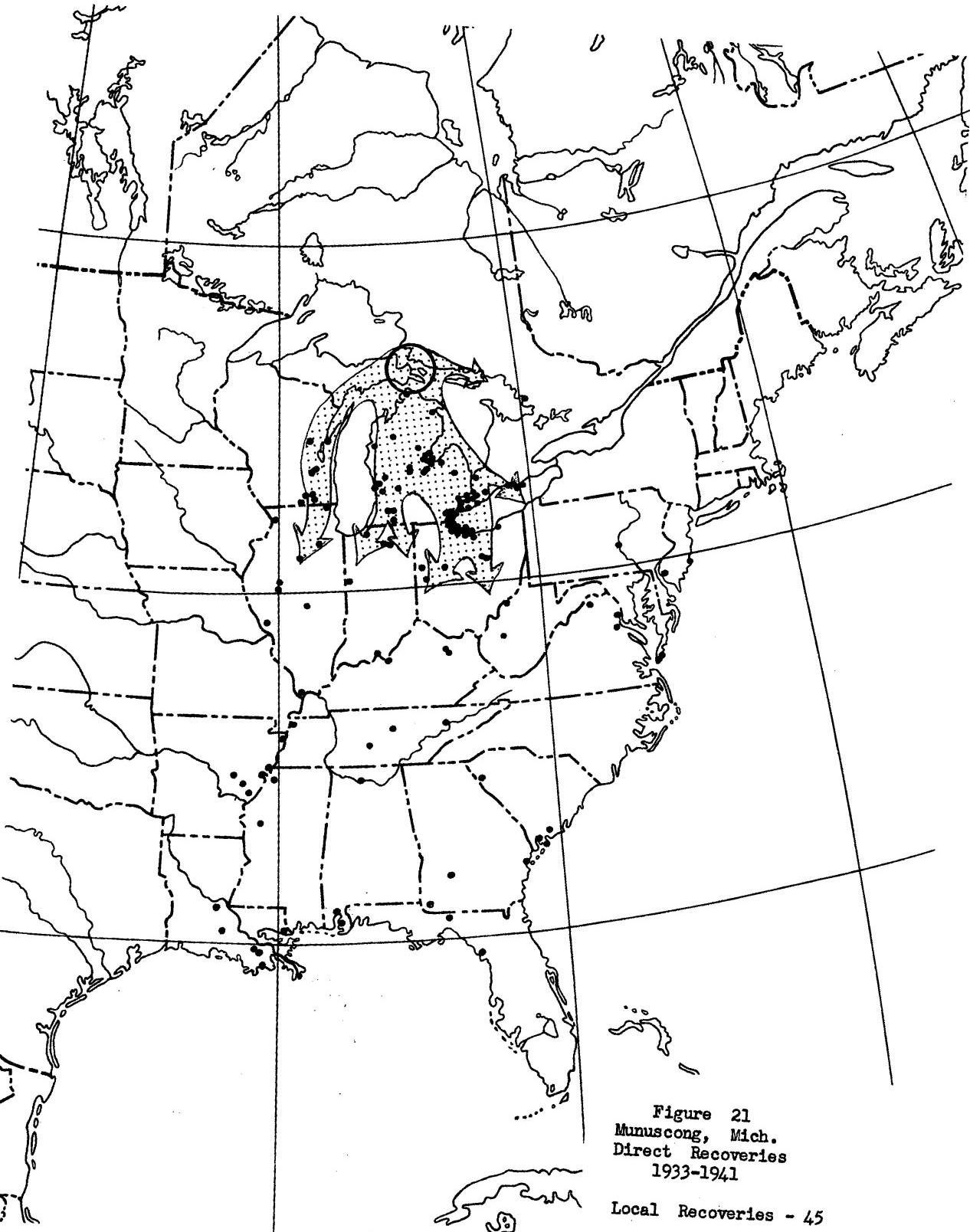


Figure 21
Munuscong, Mich.
Direct Recoveries
1933-1941

Local Recoveries - 45

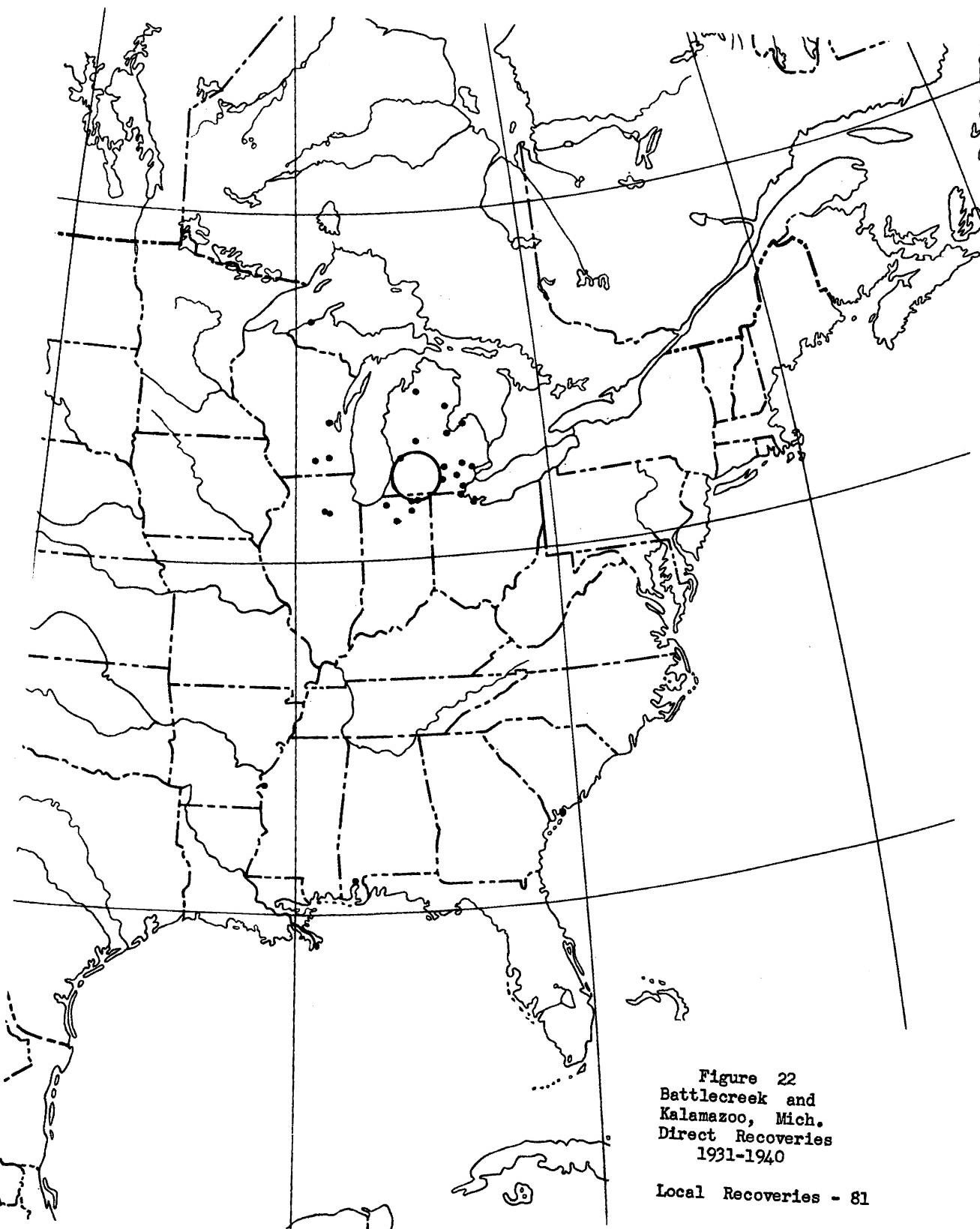


Figure 22
Battlecreek and
Kalamazoo, Mich.
Direct Recoveries
1931-1940

Local Recoveries - 81

September			October			November			December			Jan.
1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10

P.E.I.

N.B.

N.S.

Me.

Mass.

Rd. Is.

Conn.

L. Is.

N.J.

Del.

Md.

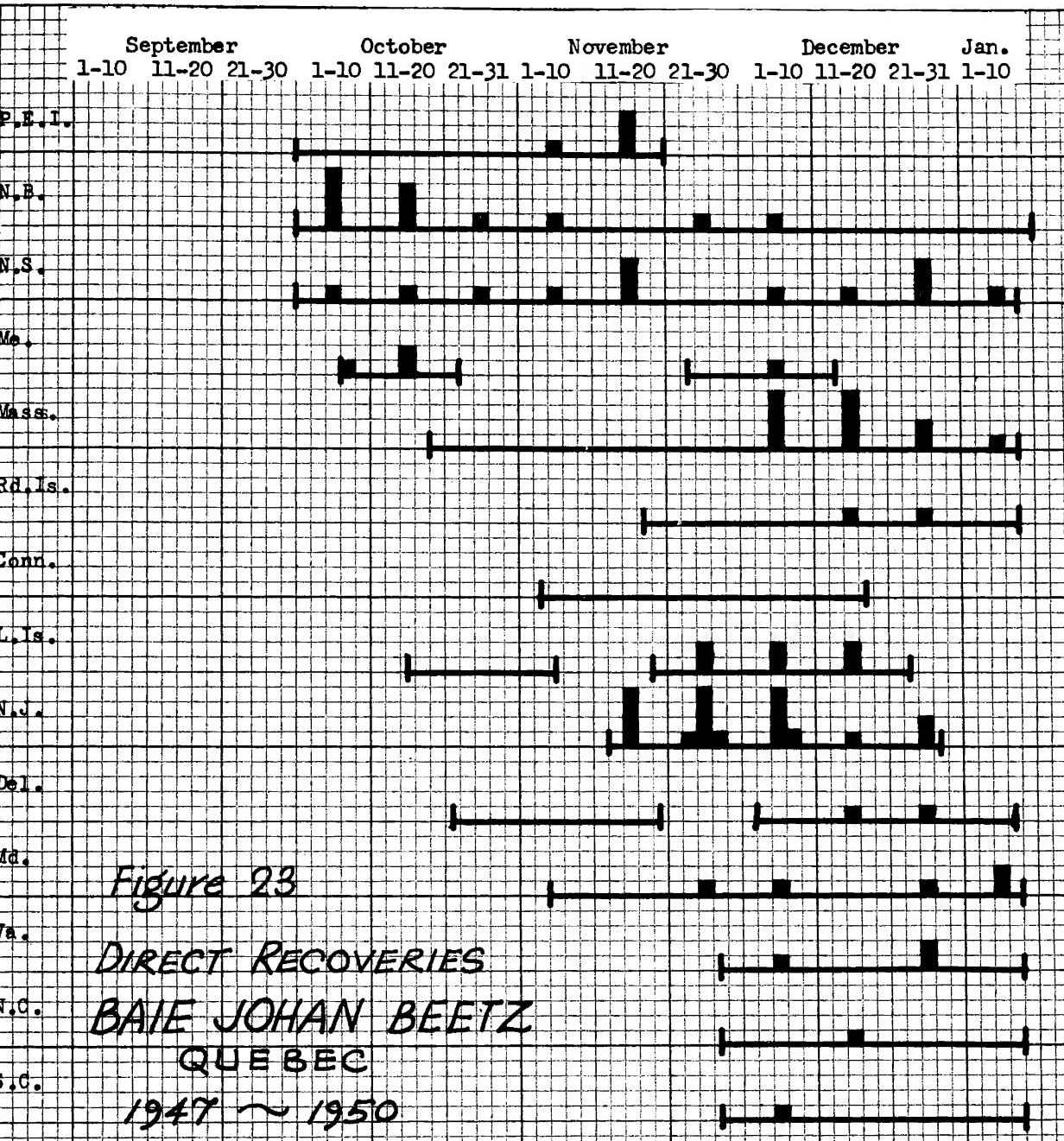
Va.

DIRECT RECOVERIES

BAIE JOHAN BEETZ

QUEBEC

1947 ~ 1950



September			October			November			December			Jan.
1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10

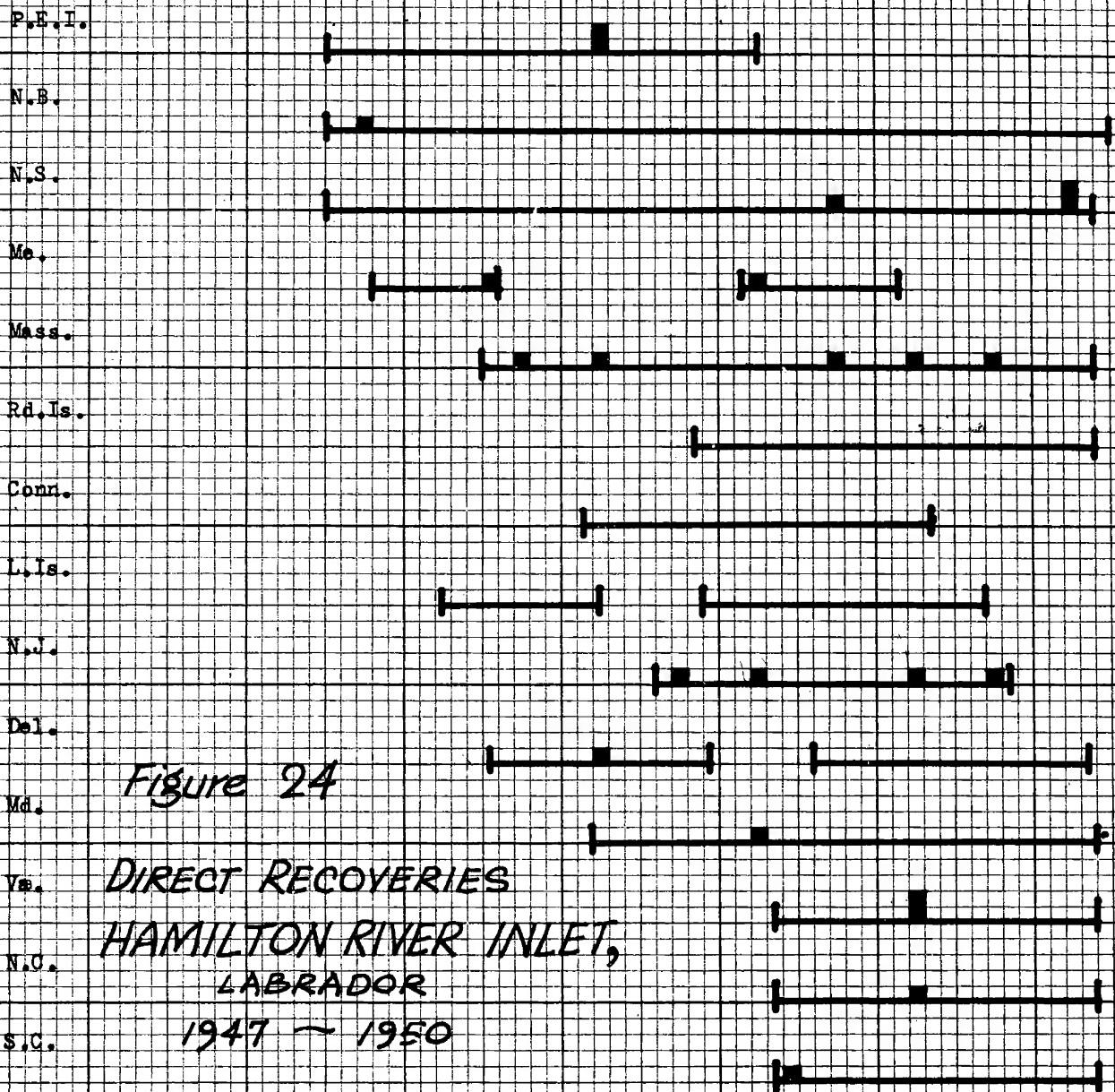


Figure 24

DIRECT RECOVERIES
HAMILTON RIVER INLET,
LABRADOR

1947 - 1950

September			October			November			December			Jan.
1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10

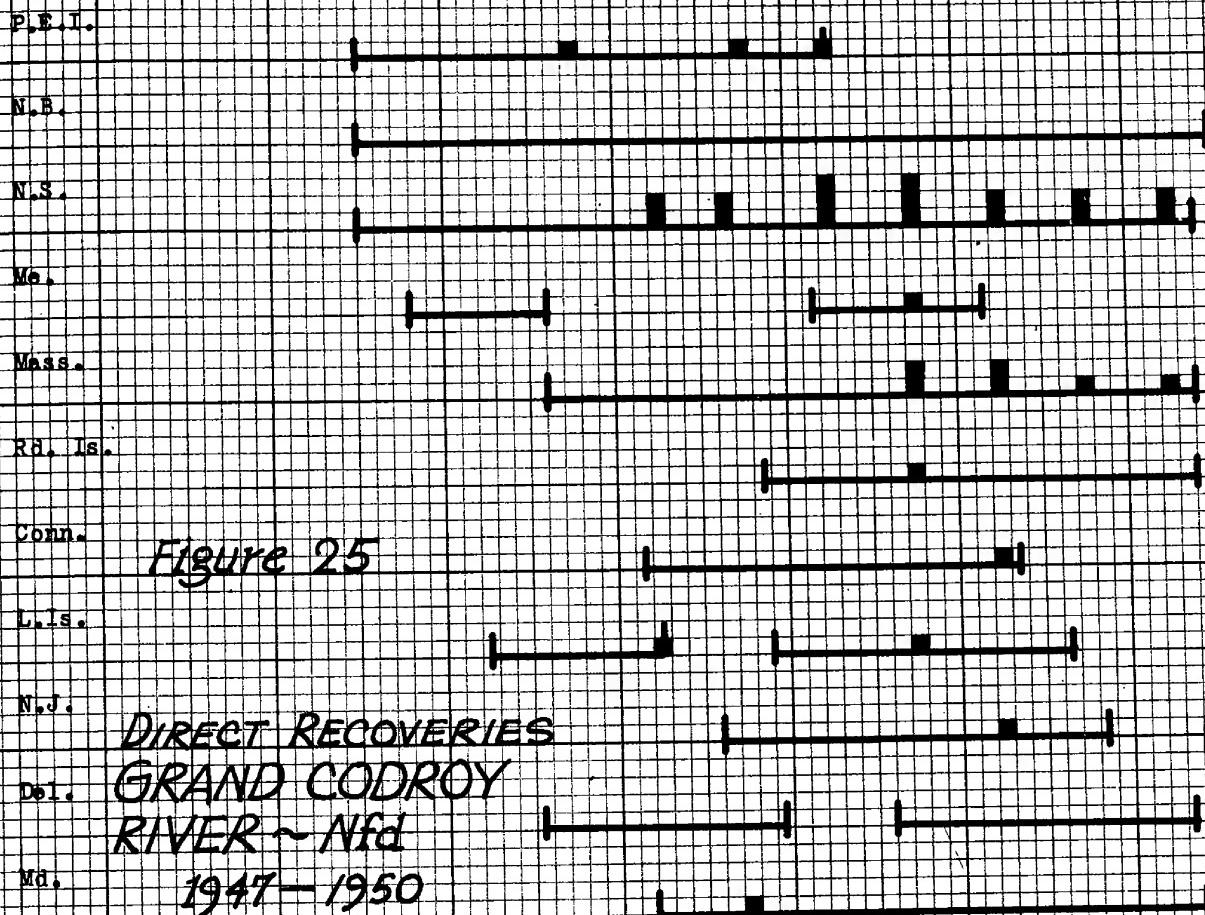


Figure 25

DIRECT RECOVERIES

GRAND CODROY

RIVER ~ Nfd

1947—1950

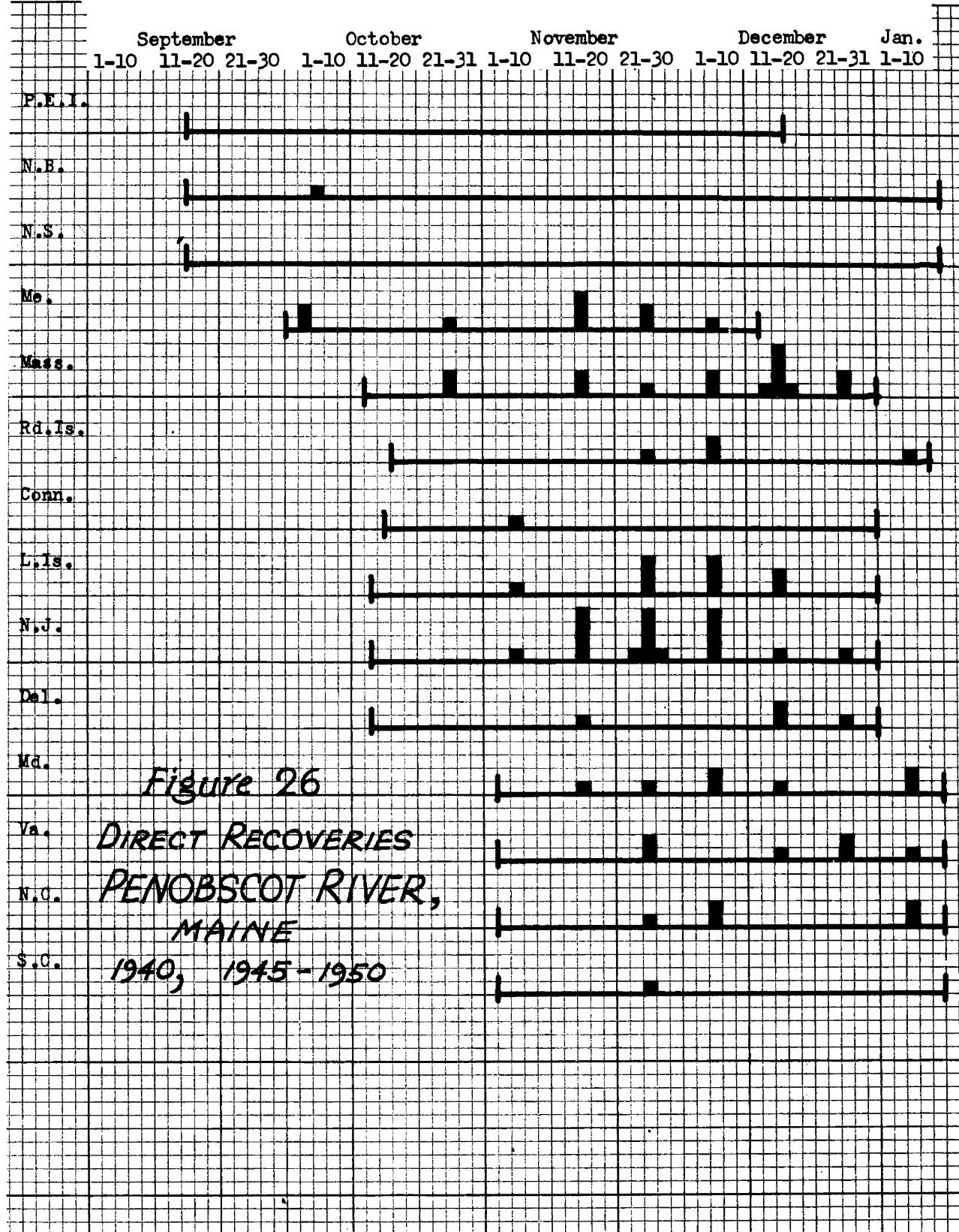
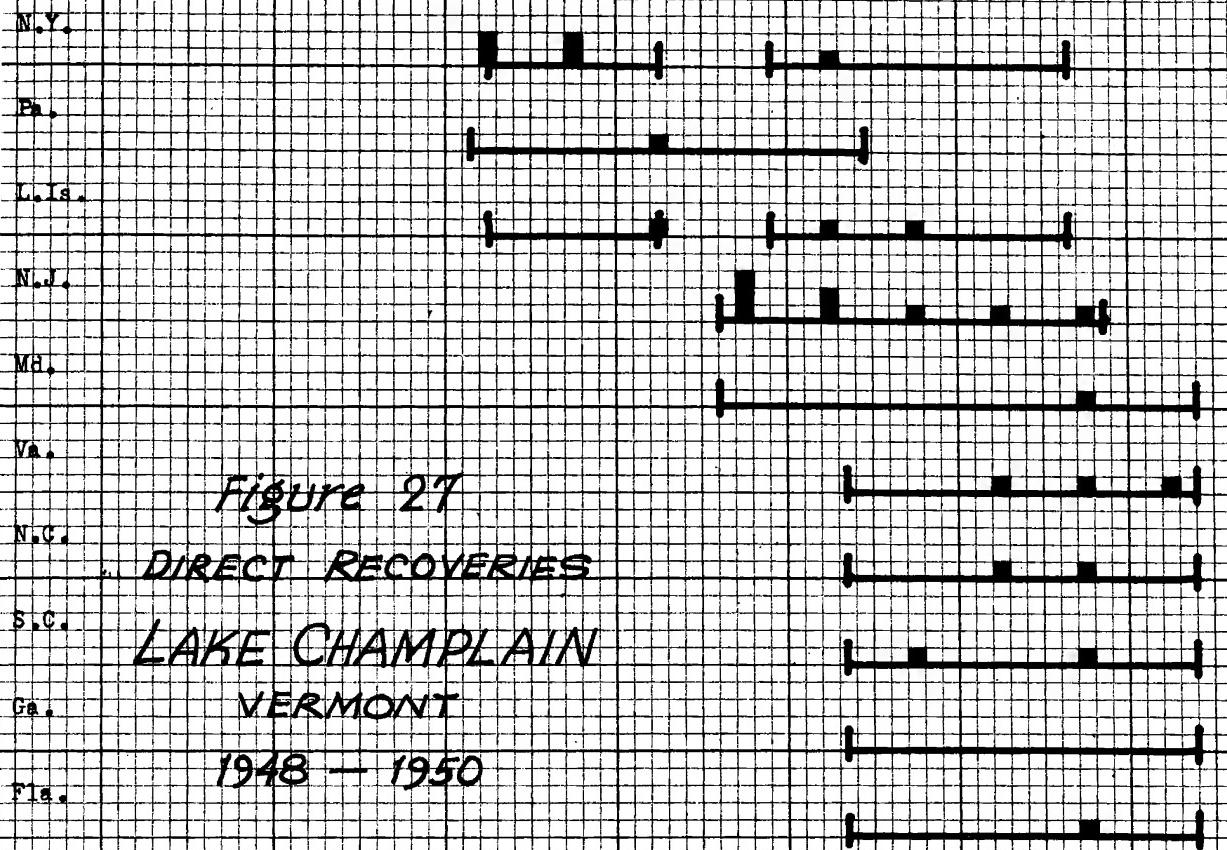


Figure 26

*DIRECT RECOVERIES
PENOBSCOT RIVER,
MAINE
1940, 1945-1950*

September October November December Jan.
1-10 11-20 21-30 1-10 11-20 21-31 1-10 11-20 21-30 1-10 11-20 21-31 1-10



	September			October			November			December			Jan.
	1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10

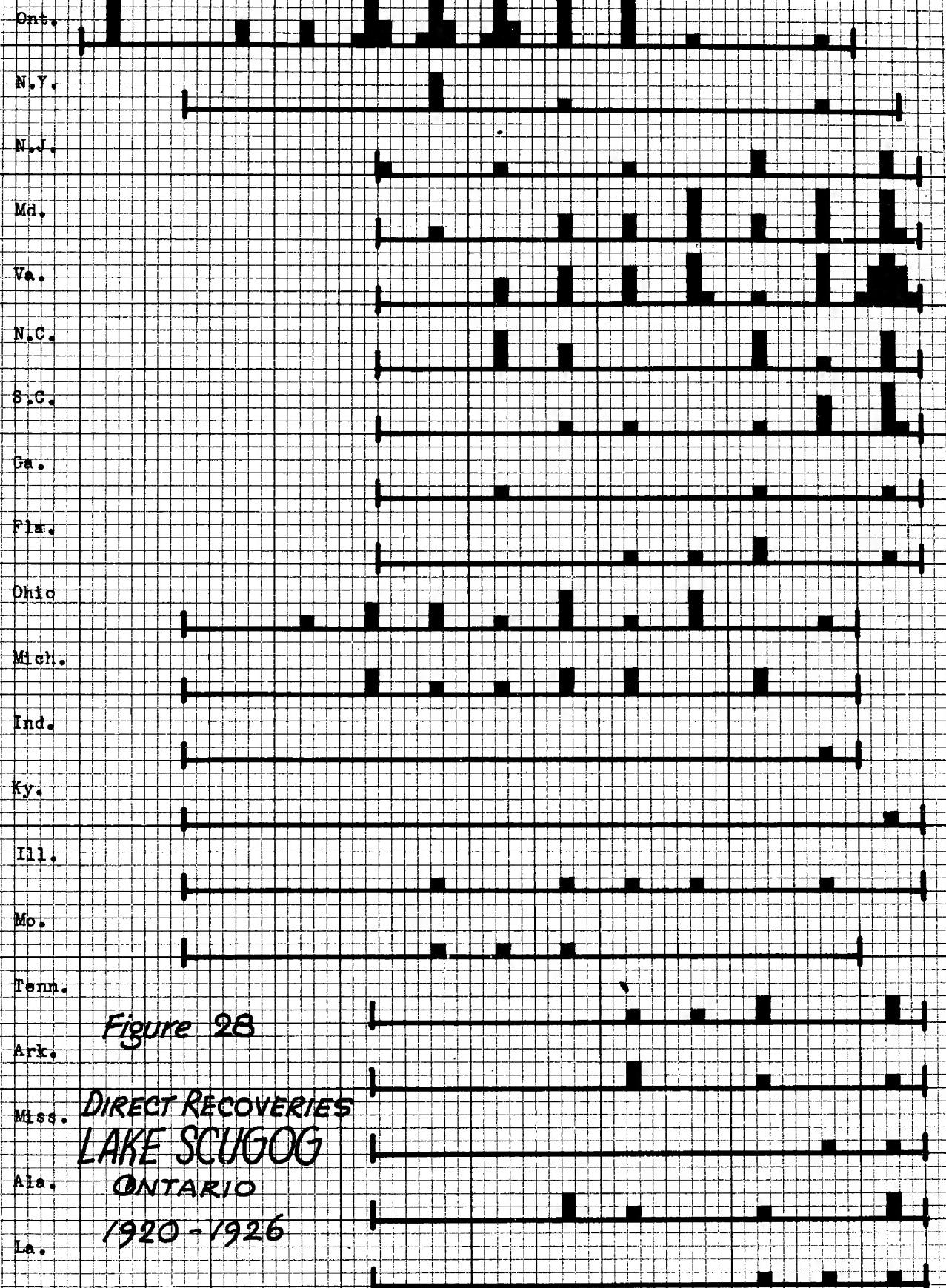


Figure 28

DIRECT RECOVERIES
LAKE SCUGOG
ONTARIO
1920-1926

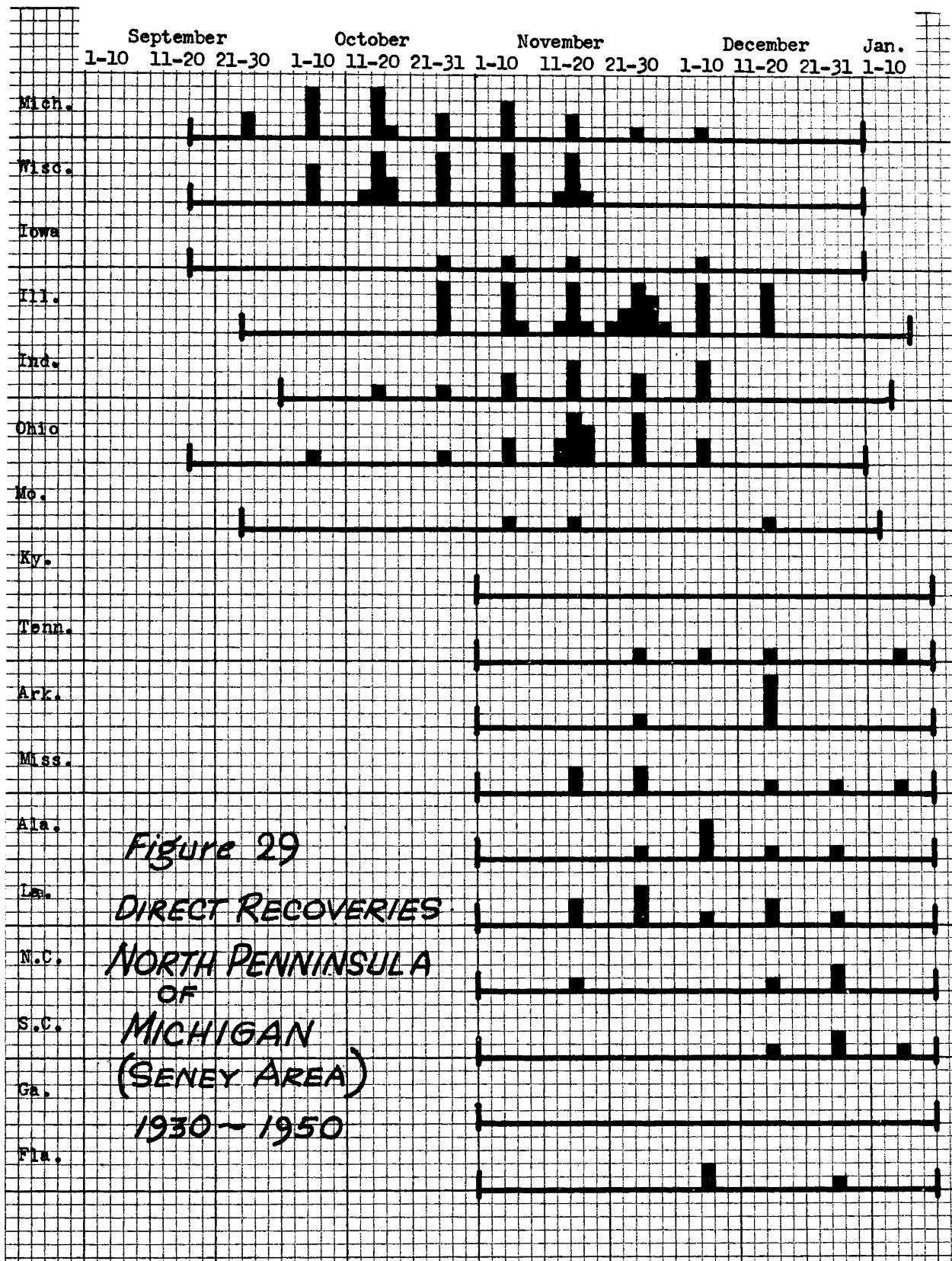


Figure 29

DIRECT RECOVERIES

NORTH PENINSULA
OF
MICHIGAN
(SENEY AREA)

1930 - 1950

September			October			November			December			Jan.
1-10	11-20	21-30	1-10	11-20	21-31	1-10	11-20	21-30	1-10	11-20	21-31	1-10

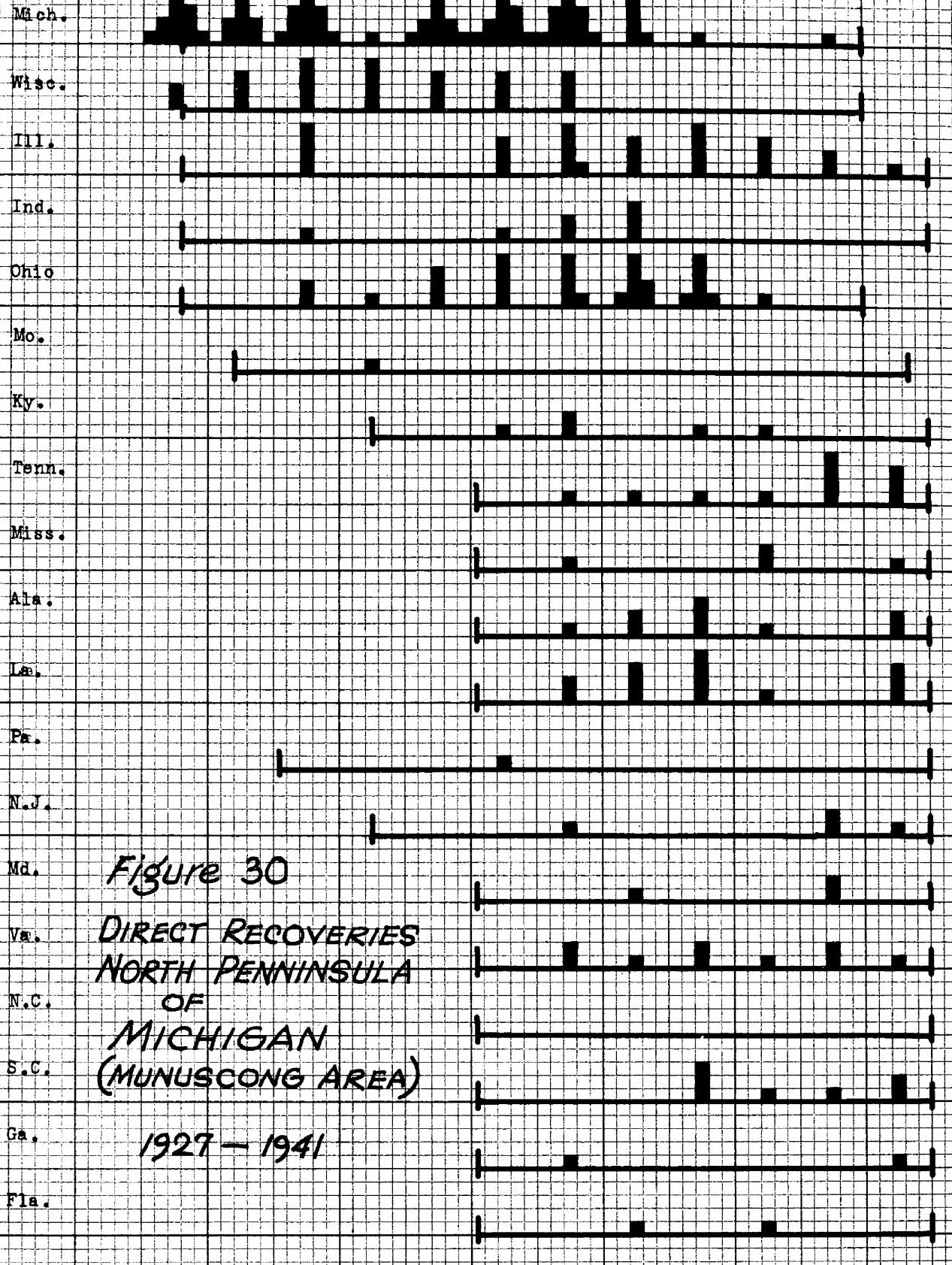


Figure 30

DIRECT RECOVERIES
NORTH PENINSULA
OF
MICHIGAN
(MUNUSCONG AREA)

1927 - 1941

September October November December Jan.
1-10 11-20 21-30 1-10 11-20 21-31 1-10 11-20 21-30 1-10 11-20 21-31 1-10

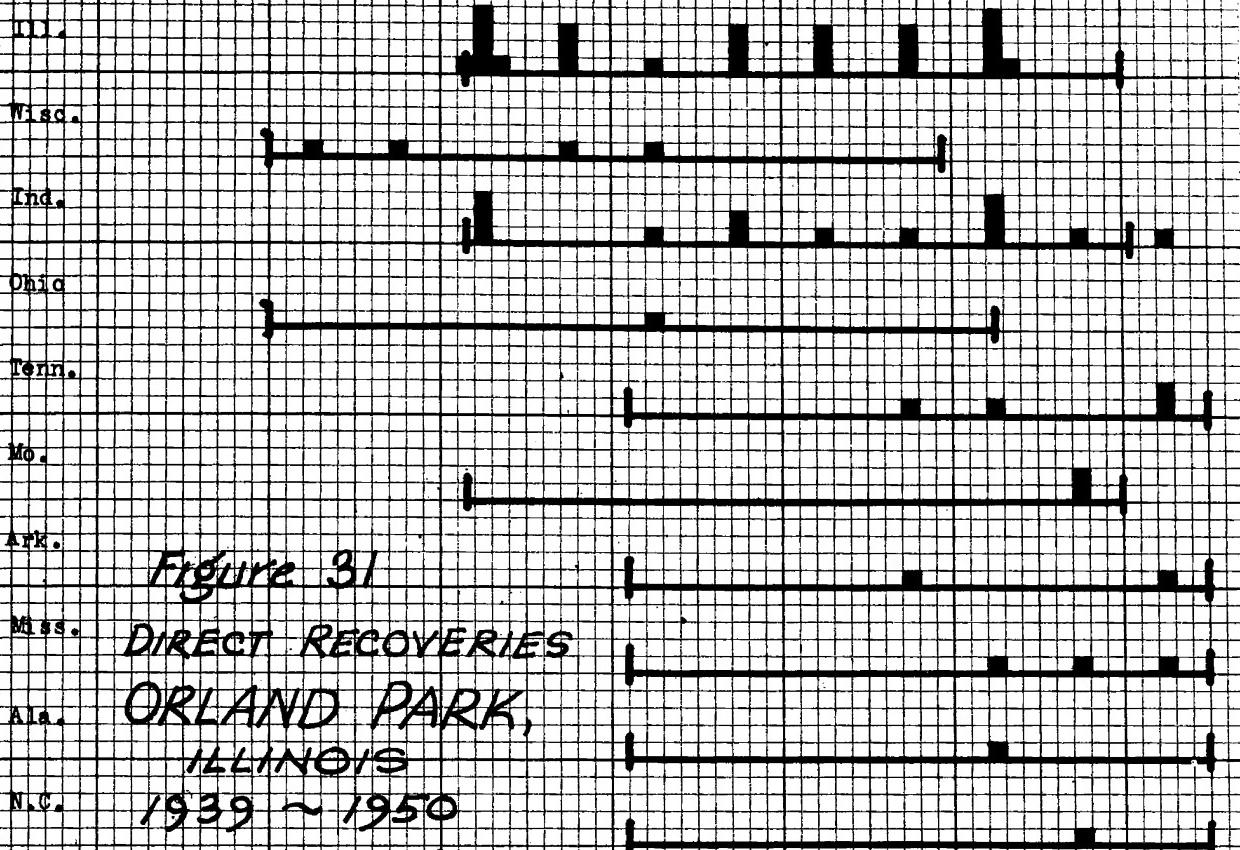


Figure 31

DIRECT RECOVERIES
ORLAND PARK,
ILLINOIS

1939 ~ 1950

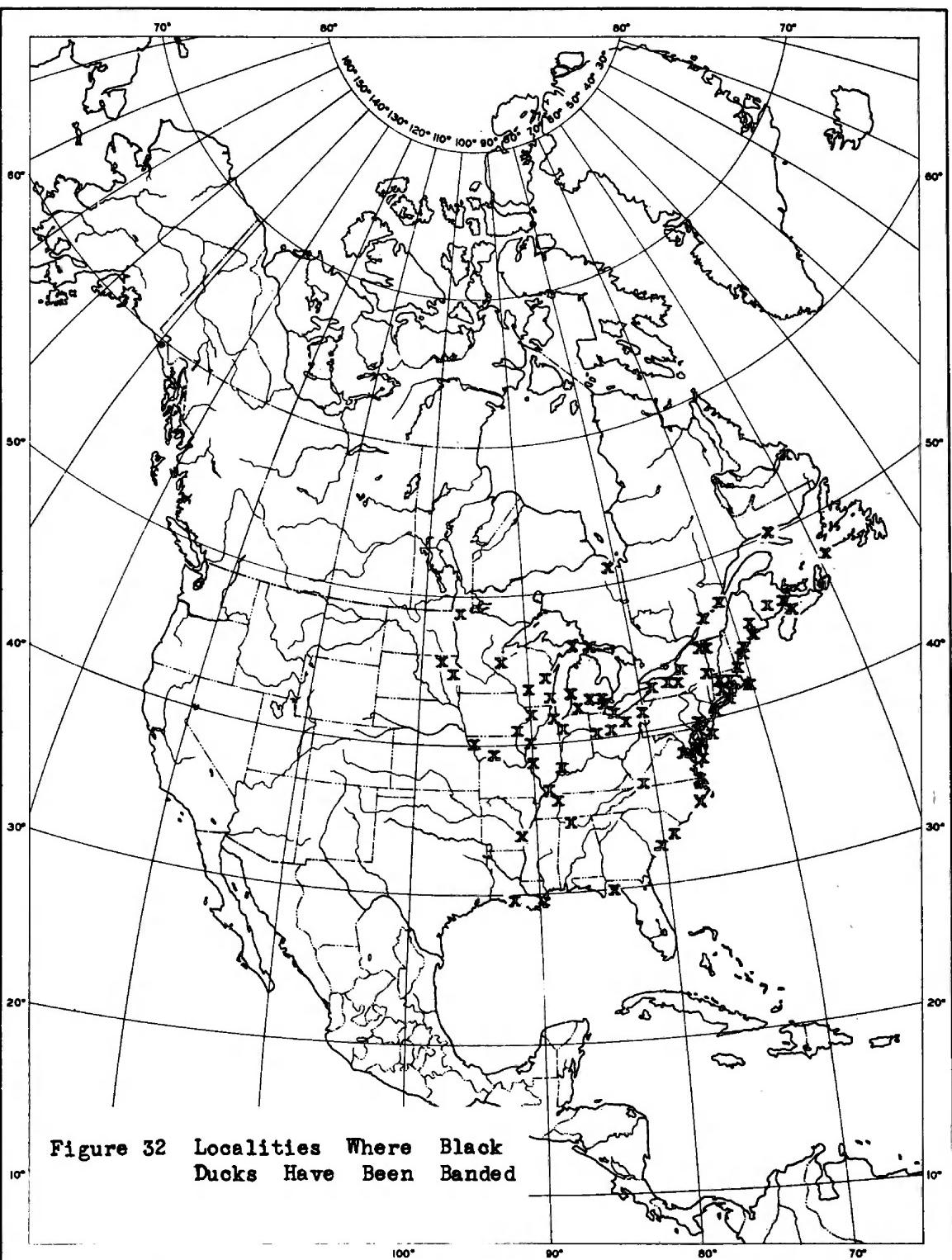


Figure 32 Localities Where Black Ducks Have Been Banded

Scale in Miles
0 300 600 900 1200